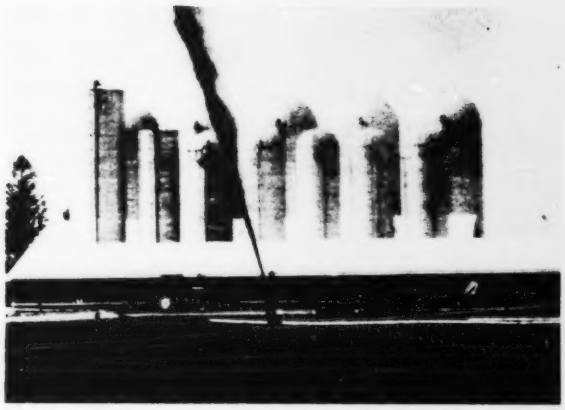
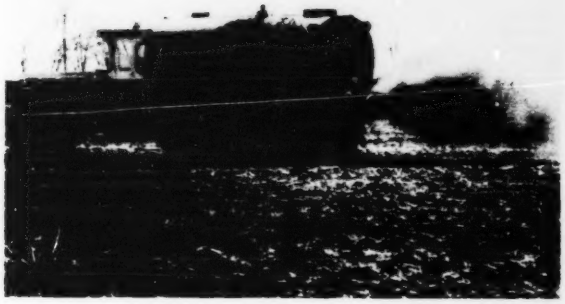
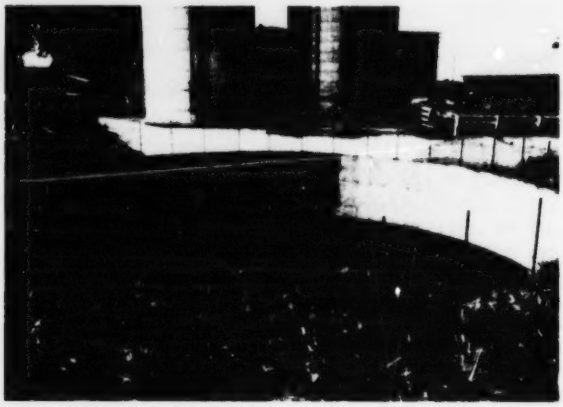
1982 FIELD CROP RECOMMENDATIONS







Ontario
Ministry of Agriculture and Food

Duncan M. Allan
Deputy Minister

Hon. Lorne C. Henderson
Minister

All information and recommendations contained in this publication relating to the use of pesticides have been reviewed by the Ontario Pesticides Advisory Committee.

Space limitations in this publication restrict the amount of detail which can be included in each recommendation. Detailed recommendations are provided, by law, on the container label of commercial products. Read and follow the directions, conditions, and limitations described on such labels. This is the only way to make effective, safe use of such products (see also pages 48 to 53).

Additional information can be obtained from the local office of the Ontario Ministry of Agriculture and Food (see pages 56 to 57).

All pesticide products are registered by Agriculture Canada. No pesticide may be used on any crop for which it is not registered. Such use can result in seizure of the crop.

EMERGENCY PROCEDURES FOR PESTICIDE POISONING

If a person suspects poisoning from exposure to a pesticide by swallowing, inhalation, or contact with skin or eyes, read the label on the pesticide container and carry out the first-aid treatment suggested.

If a pesticide has come in contact with the skin or has been spilled on clothing, remove the clothing and wash the skin thoroughly with soap and warm water.

If a pesticide has come in contact with the eyes, rinse them with plenty of water for 15 minutes.

IMMEDIATELY AFTER THE FIRST-AID TREATMENT HAS BEEN GIVEN, WRAP THE PATIENT IN A COAT OR BLANKET AND RUSH HIM TO THE NEAREST HOSPITAL, TAKING THE LABELLED PESTICIDE CONTAINER WITH YOU.

FIRST-AID TREATMENT

The Occupational Health and Safety Division, Ministry of Labour, 400 University Ave., Toronto, M7A 1T7, has physicians available for consultation on first-aid information and advice. They can be contacted in the following manner:

Between the hours of 8:00 a.m. and 5:00 p.m. Monday to Friday, telephone (416) 965-3610.
During weekends, public holidays and non-office hours telephone (416) 965-1211 and ask for the "on-call" physician.

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CORN

CROP MANAGEMENT

Seeding Date and Planting Depth Optimum seeding date centers on May 7 in southwestern Ontario, and May 10 in central and eastern Ontario. Those seeding earlier commonly must contend with lower soil and air temperatures. Studies show there is a relationship between emergence, temperature, and depth of seeding. The early seeding should be sown shallow (3 to 5 cm at a maximum). If they are sown deeper, a delay and reduction in emergence can occur. The result is an uneven stand. For later seedings (temperature is warmer) there may be a slight slowing of emergence for deeper plantings but the reduction in stand likely will be small.

Seed Size All seed sold for plate-type planters is sized in three dimensions; length, width and thickness. Although there are a large number of different seed sizes for any one hybrid, all bags of seed sold have a recommended seed plate for the specific size of seed in the bag for most common makes of plate planters. With plate planters, the desirable situation is to have one seed in each cell of the plate with no misses, no doubles and no split seed. However, one way to check that you are getting the desired plant stands is to calibrate your planter on a hard surface at field speed. With plateless planters, manufacturers' instructions should be followed to insure accurate seeding rates with all seed sizes. All seed sizes within a hybrid are identical in terms of genetic potential. There is no evidence that large seeds of one hybrid will produce larger plants and thus more yield than smaller seeds of the same hybrid.

Plant Populations A final plant population of 47,000 to 60,000 plants per hectare is recommended, irrespective of the row width used. However, on making a final decision on what plant population to aim for, several additional factors should be considered.

1. The final plant stand should be 47,000 plants per hectare where the yield levels have tended to be low and plant lodging is a problem. On soils that are low in fertility, susceptible to drought, or imperfectly drained, the lower populations are well worth considering. The population should also be lowered under late planting conditions.
2. Consideration should be given to increasing plant density to 60,000 plants per hectare on farms with a history of high yields and low plant lodging. On fertile, well-drained soils with high moisture-holding capacity, an increased plant density is most likely to return dividends. Higher plant populations are more often warranted in the shorter season areas (less than 2900 heat units), and under conditions where corn is planted early.
3. Consideration may be given to increasing plant populations in corn that is being produced for whole plant silage to between 60,000 and 69,000 plants per hectare. These higher populations have given highest yields in Ontario research trials, with no effect on grain content or dry matter percentage of the silage. Populations above 60,000 plants per hectare should not be used on drought soils, when the crop might be harvested for grain, or in regions with 3100 or more heat units. Increased populations will lead to greater stalk breakage for corn that is being produced for grain. This will not occur in corn harvested for whole plant silage because corn silage is harvested at an earlier stage of growth.

The reason for increasing plant density is to try and realize a higher harvested yield per acre. However, as the plant density is increased, the plants are under greater stress since there are more plants competing for the moisture, fertility and light available. With denser plant stands any additional stress such as drought, low fertility, weed competition, insects or diseases will have a more detrimental effect on grain yield, grain quality and lodging. It is quite probable that slight increases in grain yield could be lost at harvesttime due to increased harvesting losses resulting from smaller ears and more lodging.

The following table gives the distance between seeds required to achieve a specified population.

HYBRID SELECTION

1982 Recommended Hybrids Corn hybrids suitable to Ontario conditions are listed in the *1982 Ontario Hybrid Corn Performance Trial Report*. Growers are strongly advised to consult this report for information on the performance of recommended hybrids for their specific heat unit area.

Choosing Hybrids For Your Farm By Heat Units Locate the vicinity of your farm on the map below and estimate the heat unit rating for your farm. If you plant corn BEFORE mid-May, choose a hybrid from among those on the recommend-

Centimetres Between Seeds to Achieve Specific Populations

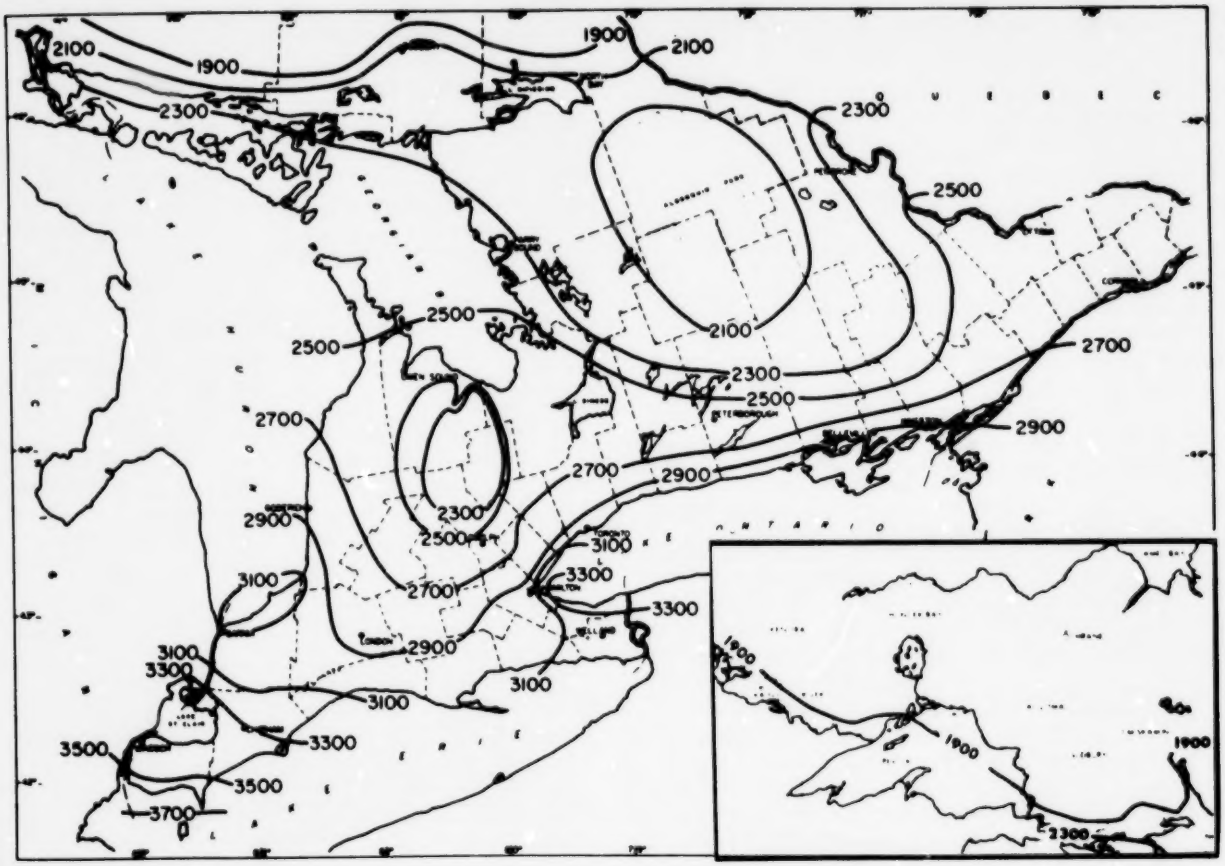
Final	Seed	Row Width — centimetres***						
Plants/hectare*	Per hectare**	71	76	81	86	91	97	102
40,000	43,900	32	30	28	26	25	24	22
44,000	49,400	28	27	25	24	22	21	20
49,000	54,900	26	24	22	21	20	19	18
54,000	60,400	23	22	20	19	18	17	16
59,000	65,900	21	20	19	18	17	16	15
64,000	71,400	19	18	17	16	15	14	13

* *1 hectare = 2.47 acres*

** *Based on 10% loss of plants. With planting after the optimum planting date, a loss of 5% of the plants may be more realistic.*

*** *1 centimetre = 0.39 inches*

Heat Units Available for Corn Production



ed list having EQUAL or LOWER rating than your farm.

If soil conditions or any other factor on your farm usually DELAY planting later than mid-May, then for a DELAY of one week or more, DEDUCT 100 heat units for EACH week from the rating for your farm and select hybrids from the list having that rating, or a LOWER rating.

Research and experience have demonstrated that hybrids producing high grain yields also produce high silage yields.

FERTILIZERS FOR CORN

Fertilizer requirements for corn in Ontario can best be estimated by using a soil test along with information on past management. Fertilizer recommendations are based on the results of trials run on research stations and farm fields in Ontario. The recommendations in this publication can be expected to produce the highest economic returns from the crop when good or above average management is used.

To provide dependable fertilizer recommendations each field should be tested at least once every third year. When large amounts of nutrients are removed from sandy soils (e.g. with crops such as hay, corn silage, potatoes, tomatoes), annual testing is advisable as potash soil tests can change rapidly under those conditions.

Where a soil test is not available a rough estimate of fertilizer requirements can be obtained from the accompanying table using the following guidelines:

(a) Where the field has been fertilized regularly for a number of years or heavily in recent years, use one of the rates of phosphate and potash recommended for the **medium** soil test rating (see table on page 4);

(b) If the field has received little fertilizer in the past, use one of the rates recommended for **low** soil test rating (see table on page 4). Some clay and clay loam soils are naturally high in potassium and do not require any potash fertilizer. Only a soil test can adequately determine potash requirements.

Nitrogen

No soil test is available which is satisfactory for nitrogen under Ontario conditions. Nitrogen fertilizer recommendations for corn are, therefore, based on the region of the province and the expected yield and adjusted downward if manure is applied or if the previous crop contains perennial legumes such as alfalfa.

Nitrogen (N) Recommended for Corn for Southwestern Ontario

The most profitable rate of nitrogen application is affected by the price of corn and the price of nitrogen. The table on page 4 shows the relationship for the Counties of Essex, Kent and Lambton and for the clay and clay loam soils of Huron, Perth, Middlesex and Elgin.

Relation of Corn and Nitrogen Prices to the Most Profitable Sidedressed Nitrogen Applications for Southwestern Ontario*

(The Counties of Essex, Kent and Lambton and clay and clay loam soils in Elgin, Huron, Middlesex and Perth)

Price Ratio corn $/t	Expected Yield** grain — t/ha			
N $/kg	6	7	8	9
	Most profitable nitrogen application kg N/ha***			
100	75	80	90	95
200	115	125	140	150
300*	135	150*	165	185
400	145	160	180	200

100 kg/ha = 90 lb/ac.

* *To use the table, the price of corn must be known or estimated. Corn at $150/t and nitrogen at $0.50/kg results in a price ratio of 300. At these prices and an expected yield of 7 t/ha you should use 150 kg N/ha.*

** *Expected yield is that yield which from experience you expect from your soil, climate and management. One tonne grain yield is equivalent to 5 t silage.*

*** *Nitrogen rates presented are for sidedress application. For preplant application an additional 30 kg N/ha should be applied. Nitrogen rates should be adjusted downward if the preceding crop was a legume sod (see page 42), or if manure is applied (see page 42).*

Nitrogen (N) Recommended for Corn for Eastern and Central Ontario and sandy loam, loam and silt loam soils in Elgin, Huron, Middlesex and Perth Counties*

Expected Yield*		Nitrogen (N)** required
Shelled Corn	Silage Corn	
t/ha***	t/ha	kg/ha***
5	25	80
6	30	100
7	35	120
8	40	140
9	45	160

* *Expected yield is that yield which your experience indicates you should obtain under your conditions of soil, climate and management.*

** *Nitrogen rates should be adjusted downward if the preceding crop was a legume sod (see page 42) or if manure is applied (see page 42).*

*** *1 t/ha = 0.45 ton/ac = 16 bu/acre*
100 kg/ha = 90 lb/ac

Phosphate and Potash

Phosphate and potash requirements for corn are presented in the table on page 4. These recommendations are based on soil tests conducted in the Ontario Ministry of Agriculture and Food (OMAF) soil testing laboratory at the Department of Land Resource Science, University of Guelph. These tables should not be used with soil test readings from other soil testing laboratories unless the methods used are identical to those used in the OMAF laboratory.

Phosphate and Potash Requirements for Corn Based on OMAF Soil Tests

Phosphorus Soil test	Rating	Phosphate (P_2O_5)* required — kg/ha	Potassium Soil test	Rating	Potash (K_2O)* required — kg/ha
0 — 3		110	0 — 15		170
4 — 5	LOW	100	16 — 30	LOW	160
6 — 7		90	31 — 45		140
8 — 9		70	46 — 60		110
10 — 12		50	61 — 80		80
13 — 15	MEDIUM	20	81 — 100	MEDIUM	50
16 — 20		20	101 — 120		30
21 — 30	HIGH	0	121 — 150	HIGH	0
31 — 60	VERY HIGH	0	151 — 250	VERY HIGH	0
61 +	EXCESSIVE**	0	250 +	EXCESSIVE**	0

100 kg/ha = 90 lb/ac.

* *Where manure is applied reduce the fertilizer application according to the amount and quality of manure (see page 42). Example of fertilizer application: If the expected yield of corn grain in a particular field in Oxford County is 7 t/ha, the nitrogen recommendation would be 120 kg/ha (see table on page 4). If the soil tests are 11 for phosphorus and 110 for potassium, the phosphate requirement is 50 kg/ha and the potash requirement 30 kg/ha (from above table). The phosphate can be supplied by 160 kg/ha (50 ÷ 32 x 100) of 8-32-16 applied 5 cm to the side and 5 cm below the seed at planting. It would supply 12 kg nitrogen and 25 kg potash/ha. The remaining 108 kg N/ha can be supplied with 130 kg (108 ÷ 82 x 100) kg of 82-0-0.*

** *For a nutrient which has an excessive rating by soil analysis, the application of this nutrient in fertilizer or manure may cause problems due to reduced crop yield or quality. Phosphorus additions may induce zinc deficiency on soils low in zinc and increase the risk of water pollution. Potash additions may induce magnesium deficiency on soils low in magnesium.*

Methods of Application

Nitrogen should be applied in the spring with the major portion either as a preplant application or side-dressed before the corn is 30 cm high. Fall application of nitrogen is not recommended. In Essex, Kent and Lambton Counties and on the clay and clay loam soils of Huron, Perth, Middlesex, and Elgin, preplant applications of nitrogen have not been as efficient as side-dressed applications. For preplant application an additional 30 kg N/ha should be applied. On these soils in this area anhydrous ammonia has produced 3-5% higher yields than ammonium nitrate or urea. In the remainder of Ontario, preplant application is equal to side-dress application.

Solid forms of nitrogen or 28 to 32% solutions may be applied to the surface of the soil without incorporation. Under dry conditions the effectiveness of all forms of nitrogen fertilizer may be improved by incorporation. If the fertilizer solutions contact leaves, burning and yield reductions are likely to occur.

Anhydrous ammonia, applied with conventional equipment, should be placed a minimum of 15 cm deep in the soil. When appropriate equipment is used, ammonia may be applied with a cultivator or disc a minimum of 10 cm deep with the ammonia outlets spaced no more than 45 cm apart. Because anhydrous ammonia may damage plants, it is preferable to make a pre-plant application crossways to the direction the corn will be planted.

The major portion of the phosphorus and potassium may be broadcast and plowed or worked into the soil either in the fall or spring. However, where soil tests show a requirement for these nutrients a fertilizer containing nitrogen and phosphorus or nitrogen, phosphorus and potassium should be applied as a starter at planting time.

The starter fertilizer should be applied in one of two ways:

1. In a band 5 cm to the side and 5 cm below the seed. The rate of application in the side band should not supply more than 55 kg of nitrogen per hectare or a total of 90 kg of nitrogen plus potash (K_2O) per hectare in one metre rows. If urea is the nitrogen source, not more than 30 kg of nitrogen or 60 kg of nitrogen plus potash per hectare in one metre rows.
2. In a band directly with the seed. With this placement not more than 7 kg nitrogen plus potash (K_2O) per hectare should be applied in one metre rows. Neither urea nor diammonium phosphate should be applied with the seed.

To Calculate Nitrogen and Potash Content

100 kilograms 6-24-24 per hectare provides 6 kg nitrogen and 24 kg potash for a total of 30 kg.

200 kg 8-32-16 provides 16 kg nitrogen and 32 kg potash for a total of 48 kg.

Low rates of fertilizer may be placed closer to the seed with advantage, provided extreme care is exercised in selection of rates and analyses. Consult your extension specialist before using this practice.

DISEASE AND INSECT CONTROL IN CORN

(see page 48 to 53)

Seed Treatment

Seed corn sold in Ontario has been treated with a fungicide, such as captan, Vitaflo 280 or thiram, for protection against *seed decay* organisms. A treatment may also have been applied to control insects that attack seed in storage. Additional treatments to protect seeds from soil inhabiting insects should be applied every year. Use diazinon to reduce damage by *seed maggots* and lindane for protection from *wireworms*. Seed treatment combinations of diazinon and lindane are available from seed suppliers and should be applied as recommended. Follow the directions on the label with care. Thorough mixing is important.

Apply insecticides to the seed just before planting or mix them with the seed in the planter box. Use a wooden paddle to mix the chemicals and seed.

WARNING

The concentrations of insecticides in seed treatments are high and thus the products are quite toxic. Wear rubber gloves, full protective clothing, and a respirator when treating seed. Avoid skin contact and breathing of the vapors. Do not handle treated seed with bare hands. Dispose of surplus treated seeds by burying it under 50 cm of soil in an area away from water supplies.

DISEASES

General Preventive Measures

1. Plant hybrids resistant to leaf blights and stalk rot (see below and check with seed company).
2. Plow under old cornstalks and leaves to help kill overwintering disease fungi.
3. Rotate corn with other crops to help prevent disease buildup.
4. Minimize plant stress by:
   (a) Avoiding plant populations that are too high for the hybrid grown.
   (b) Maintaining high soil fertility, good soil structure, and good drainage.

Leaf blights Hybrids tolerant to *southern leaf blight* and *yellow leaf blight* are strongly recommended. Seed of tolerant hybrids at present is produced on detasselled plants having "normal" (or "N") cytoplasm. Most seed is now of this type. Hybrids grown from seed on Texas male sterile plants (with "T" cytoplasm) are susceptible to southern and yellow leaf blights.

Hybrids usually tolerate *northern leaf blight*, but the disease may be a problem if leaves remain wet from dew or rain throughout most of the day.

Eyespot is usually severe only in fields with much corn debris from the previous season or on highly susceptible hybrids. Plow under corn debris cleanly and use more resistant hybrids.

Stalk Rot Grow hybrids with low stalk breakage counts, as listed in the current *Ontario Hybrid Corn Performance Trials*. Copies are available from your county office of the Ministry of Agriculture and Food. Stalk rot is often serious in fields with high plant populations, low fertility, and poor soil conditions. Harvest as early as possible because stalk rot develops mostly on mature plants and becomes a greater problem the longer the crop is left in the field.

Ear Rot Pink, white, green and black molds may develop on ears. The pink molds, and less often the white molds, may produce toxins, including estrogens and vomitoxin, which have serious effects on livestock, especially pigs and poultry. The green and black molds do not normally pose a problem except when, in great abundance, they may put livestock off feed. Development of the ear rots is stopped when

Hybrids Resistant to Head Smut in 1980 and 1981 Field Trials

2400-2625 H.U.	2625-2900 H.U.	2900-3100 H.U.	3100-3400 H.U.
Pickseed 2288	Pickseed 2277	Speare S0123	N.K. PX49
Trojan-Warwick T778	Pickseed 4944	Funk G-4295	Funk G-4323
Pride 1108	Trojan-Warwick T833	Trojan-Warwick W966	N.K. PX37
Labonté 1803	Asgrow RX36	Hyland HL2454	Pioneer 3780
PAG SX111	DeKalb XL6	Hyland HL2458	DeKalb XL25A
Bishop 30-06	Trojan-Warwick T855	Cardinal 3222	Pickseed 9911
Pride 1122	Stewart 280	Pride 4461	Pioneer 3780A
Trojan-Warwick W777	Hyland HL2216	Stewart 290	Jacques JX177
Cardinal 2222	Speare S0109	Cardinal SX98	Renk RK66E
Pickseed 2333	Pride R141	Seneca 321	Asgrow RX610
Cardinal SX85A	Funk G-4112	N.K. PX9252	Renk R146
Pickseed 2555A	Hyland HL2430	Co-op M285	PAG 872
Hyland HL2219	Pickseed 6266	Funk G-4141	Renk RK66
Co-op S259	Stewart 8077	PAG 834	Embro X45
Co-op 2430	Trojan-Warwick W844	Funk G-4256	N.K. PX9454
Pickseed 2344	Asgrow RX42	Cardinal SX93	Co-op 3440
Pride 1111	Cargill 810	Pride 2206	N.K. PX39
Co-op 2610	Pride 1128	Pioneer 3780A	Pride 4488
Oseco UC1108	Pride 1131	Co-op M279	Stewart 338
Labonté 3S	Pioneer 3925	N.K. PX21	Pride 5525
Embro X13	N.K. PX14	DeKalb XL14AA	Trojan-Warwick W1101
Funk G-4065	Seneca 149	N.K. PX9288	DeKalb XL18
Speare S0102	DeKalb XL11	Funk G-4150	Embro X36
Hyland HL2220	Pride 1169	Renk R136	Cardinal SX112
Cardinal 2320	Asgrow RX383	DeKalb XL15	Oseco UC2981
Pickseed 2555		N.K. PX22	PAG SX181
		Renk RK18	Pride 5511
		Trojan-Warwick TXS94	Renk RK15
		Pioneer 3906	Trojan-Warwick T1055
		Hyland HL2442	DeKalb XL32A
			Speare S0131

corn is dried, acid treated or ensiled, but the level of harmful toxins, if present, remains unchanged. Where corn is stored in cribs these fungi will, under favorable weather conditions, continue to grow and produce toxin until corn moisture drops below 20%. See Ontario Ministry of Agriculture and Food Factsheet, *Moldy Feeds and Swine Diseases*, Agdex 440/60.

Storage and Feeding Precautions

1. Exercise caution in feeding moldy corn, especially to hogs. Pink or reddish molds are particularly harmful.
2. For assistance with problems of moldy feeds, contact the county office of the Ontario Ministry of Agriculture and Food. It may be recommended that the feedstuff be analyzed for toxins.
3. Avoid cribbing corn with pink ear rot.

Head Smut of Corn This disease was first observed in Ontario in 1979. Head smut is easily confused with common smut but is much more destructive. Usually no grain is produced in plants with head smut. Spores of the head smut fungus survive in soil for several years. Recommended hybrids differ in degree of resistance to head smut. Consult Factsheet Agdex 111/632, *Head Smut of Corn* for further details of the disease.

On farms where head smut has not been identified, there is no need to select hybrids on the basis of head smut resistance. Select hybrids based on characteristics such as yield, stalk strength, maturity, etc.

On farms where head smut has been identified, selection of hybrids with resistance should be considered (see the following table). However, be sure to also consult the *1982 Ontario Hybrid Corn Performance Report* for information on yield, stalk strength and maturity of these hybrids.

INSECTS

Corn Rootworms There are two species of corn rootworms that damage corn in Ontario. The northern corn rootworm is still the predominant species east of Toronto, while the western corn rootworm is the predominant species southwest of London.

The larval stages of these species feed on corn, causing damage by tunneling through and pruning roots from mid-June to mid-July. When full-grown the slender, white larva are about 1.5 cm long. The northern adult is a plain yellow or green beetle about 0.5 cm in length; the western adult is green with black stripes and is slightly larger than the northern adult. Both adults feed on corn silks from August to the first frost. See OMAF Factsheet, *Corn Rootworms*, Agdex 111/622.

Crop rotation is recommended to control both species of rootworms.

If crop rotation is not practical and extensive goosenecking occurs throughout a field, then check roots for evidence of rootworm feeding. When feeding is evident apply a soil insecticide at planting the following spring. Use a planter-mounted granular insecticide applicator with a spreader attachment to place an insecticide in at least a 15 cm band in front of the press wheel but not in contact with the seed. Calibrate the applicator each year and when switching chemicals. Do not use a broadcast application. To avoid wind drift and poor control, mount the spreaders as close to the ground as possible. Any one of the following insecticides may be used.

European Corn Borer Stalk breakage was more of a problem in 1980 and 1981 than in other years. Investigations showed that the number of borers per stalk was higher in a few areas, but this was not general across the province. In many areas of Ontario the population was not higher and in some areas it was lower. In general more stalk breakage did occur in Ontario in 1981 and this was due to several factors including a higher incidence of stalk rot. The breakage problem in 1982 cannot be predicted but will again depend on many factors including weather conditions, stalk rots, wind and borers.

The cream-colored female moth usually lays her eggs on the underside of corn leaves, beginning in early June in southwestern Ontario and somewhat later in other parts of the province. After hatching, the young borers feed on the leaves, giving them a pin-pricked appearance. Sometimes the feeding scars are elongate. Later, the borers work downward into the "throat" (whorl) of the plant and feed on the developing leaves. Afterwards, they enter the stalk. Control is effective only if the borers are destroyed before they enter the stalk. It is most important to select a hybrid with good standability and thus some resistance to breakage. For good stalk quality the plant population should be 47,000 plants per ha. Higher plant populations lower stalk quality and can result in more breakage. In addition, growers should plant as early as feasible to reduce the infestations by the second generation where it occurs, and to obtain as early a harvest as possible. Harvest as soon as suitable moisture levels are reached to decrease losses from dropped ears and broken stalks which occur during autumn storms.

European Corn Borer Strains

There are two distinct strains of the European corn borer in Ontario. Most areas have the strain with a single generation per year, but south of a line from Sarnia to London and Simcoe, there is present a strain with two generations per year. There is some resistance to leaf feeding by the single generation strain and the first generation of the two generation strain, but none by the second generation feeding where it occurs. The resistance ratings, as such, are not available but are reflected, among other factors, in the standability ratings available in the 1982 Report, *Ontario Hybrid Corn Performance Trial Report*.

Corn Rootworm Control

Insecticide* Applied in a 15 cm band	Rate of Product** Grams per 100 m Any Row Width	kg/ha at Row Width of 90 cm	75 cm
Birlane 10 G	85 — 110	9.4-12.2	11.3-14.6
Counter 15 G	75	8.3	10.0
Dasanit 15 G	40 — 75	4.2- 8.3	5 -10.0
Di-Syston 15 G	75	8.3	10.0
7.2 LC***	15 mL	1.6 L/ha	2 L/ha
Dyfonate 20 G	45 — 55	5.0- 6.1	6 - 7.3
10 G	90 — 110	10.0-12.2	12 -14.6
Furadan 10 G	85 — 110	9.4-12.2	11.3-14.6
Lorsban 15 G****	75	8.3	10.0
Thimet 15 G	75	8.3	10.0

G (Granular); LC (Liquid Concentrate).

* **CAUTION:** *Do not use the same insecticide two years in succession, otherwise the development of insect resistance may be promoted. All of these insecticides are extremely poisonous to the operator. Handle with care. Follow all safety precautions on the label. Only purchase what is needed for one year. Store under lock and key and not with food or animal feed. For additional information see pages 48 to 53.*

** *Use higher rate on clay soil or soil high in organic matter, and in fields with a history of severe rootworm.*

*** *Liquid concentrate must be sprayed in a 15 cm band for control. Do not apply with liquid starter fertilizer because the band is not wide enough for control of rootworms.*

**** *Placement behind the planter shoe and ahead of the press wheel is particularly important.*

Two Generation Area In the southwestern area where the two-generation strain occurs, the second generation is larger than the first, is more abundant in late planted corn, and is responsible for most of the ear loss due to damaged shanks and stalks. For this reason the non-chemical recommendations listed above are generally preferable. If insecticides are applied, use a material listed below but apply it in August against the second generation. Eggs for this generation are laid over a five-week period and eggs can be laid in any one field over a three-week period. Probably more than one application would be required for significant control.

One Generation Area Where only one generation occurs, losses can be high enough to warrant control. You should examine the plants for borer feeding before tassels show in the whorl or when plants are about 60 cm tall. Examine the plants at 10-day intervals and spray if you find that more than 50% of the plants have feeding scars. Two applications, 7 to 10 days apart, may be needed for significant control. Once the larvae bore into the stalks, treatments are not effective and should not be applied. For further information, see OMAF Factsheet, *European Corn Borer*, Agdex 111/622.

European Corn Borer Control

Insecticide	Formulation*	Product Per ha
Sevin (carbaryl)**	50% WP	3.2 kg
	80 S or 85% WP	1.9 kg
[2]Furadan	4.8 F	1.1 L

** F (Flowable); S (Sprayable); WP (Wettable Powder)*
*** Follow precautions applying to honeybees (see page 49).*
[2] Minimum period before reentry is 48 hours.

Bees often visit sweet and field corn to collect pollen. Where spraying is being done bee poisoning may result. *Sevin and Furadan are highly toxic to bees* but Sevin is the most damaging since it is carried to the hive and poisons the brood. If bees are in the area, advise local beekeepers of spraying activity and do not use Sevin. Your local agricultural representative has a listing of beekeepers in your area. Damage to bees is reduced when sprays are applied in early morning or late evening when bees are not foraging. Do not treat when the wind is blowing. Avoid contamination of roadsides and adjacent fields where plants may be in bloom.

Cutworms They are found in the soil and attack seedling corn in the two-to five-leaf stage. Plants suddenly wilt because the stem is hollowed out or cut off at or just below ground level. The cutworms can usually be found in the soil within a few inches of damaged plants. There are a number of species of cutworms and they may be gray to dark brown in color and striped or mottled. Mature cutworms are about 3.5 cm long. Cutworms that are nearly mature (over 2.5 cm long) are difficult to control but they will stop feeding in a few days when they reach full size. It is not recommended to apply insecticide in this case because most of the damage is done and it is better to wait a few days and replant. Treatment is most effective when applied soon after cutworms have hatched.

If seedling corn is attacked and the cutworms are small, apply the following treatment in at least 300 L of water per hectare.

LORSBAN (Chlorpyrifos) 4C at 3.0 L/ha. Apply once in up to 1000 L of water per hectare at the seedling (2-to 5-leaf stage) when damage first appears. LORSBAN can be applied to both field and sweet corn. Do not apply within 70 days of harvest.

Armyworm Because grassy and weedy corn is attractive to armyworm moths for egg-laying, eliminate grasses and weeds from the corn crop. The result will be less armyworm damage to corn (see Ontario Ministry of Agriculture and Food Publication 75, *Guide to Chemical Weed Control*). If armyworms move into corn fields, spray the border rows and adjacent cereals, pasture, or hay crops with one of Lannate (methomyl), malathion, methoxychlor, or Sevin (carbaryl) as recommended on the label.

Because armyworms feed only at night, effective control with any of these materials may take 2 to 3 days. Spraying in the late afternoon or evening is desirable. Malathion is less effective below 16°C. Where less than 60 L of spray are used per hectare, Lannate provides better control than the other insecticides. For rates, see armyworm control section on page 31. Read the warning about bees on page 31 before spraying inbloom forage crop.

Potato Stem Borer This pest of corn is more severe in the eastern counties of Prescott, Glengarry, Russell, Stormont, Carleton, Dundas and Renfrew, but infestations have been found throughout Ontario.

Seedling corn is destroyed by larvae (pinkish worms 4 cm long when mature) that bore into the base of plants just below or above ground level. The leaves of infested plants wilt and turn brown from the tips downward. Seedlings up to 40 cm high wither and die. Such plants break off at ground level when pulled. The worms may be found in the stalk or in the soil near the base of the plant. The larvae move to corn in late May or early June from the following plants: orchard grass, bromegrass, reed canary grass, Canada bluegrass, and from quack grass, green foxtail and some other weeds.

At present there are no effective insecticides to control the potato stem borer in the corn. To reduce potato stem borer infestations, maintain weed-free fields, borders, and fencerows by plowing, cultivation, and with the use of herbicides as outlined in OMAF Publication 75, *Guide to Chemical Weed Control*.

The primary weed hosts are perennial grasses and these must be killed in the fall or early enough in the spring to prevent the survival of borers. Herbicide treatments later than May 1st will probably do more harm than good. Evidence suggests that such treatments fail to kill borers but cause them to move to corn sooner. Where the potato stem borer has been troublesome in the past, doubling the plant stand by over-planting the border rows can help by compensating for seedling mortality.

Grasshoppers Maintain weed-free borders and fence-rows. If this insect is a problem spray the outer rows.

Grasshopper Control

Insecticide	Formulation*	Product Per ha
malathion	25% WP	3.3 kg
	50% EC	1.7 L
diazinon	50% WP	1.1 kg

**EC (Emulsifiable Concentrate); WP (Wettable Powder)*

Cereal Leaf Beetle Refer to quarantine regulations under Cereal Crops page 31 concerning movement of shelled and ear corn.

White Grubs The larvae of June beetles have plump, white bodies with large brown heads and six prominent legs. They are found in a "C"-shaped position in the soil near the roots of plants. The adults lay their eggs in sod and white grubs are therefore a problem in corn following sod, particularly run-down fields or pastures. When such fields are plowed the partly grown larvae can be found especially if the sod is broken apart and examined carefully.

To avoid damage, do not plant corn following grass sod.

Birds Information is outlined in an Ontario Ministry of Agriculture and Food Factsheet, *Bird Damage to Corn*, Agdex 111/685.

WEED CONTROL IN CORN

For weed control recommendations see OMAF Publication 75, *1982 Guide to Chemical Weed Control*.

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CROP MANAGEMENT

The production of perennial forage crops offers the Ontario farmer an opportunity to produce a substantial portion of his livestock's protein and energy requirements. In order to accomplish this, his perennial forage crops must be managed to the same degree as other high producing crops grown on the farm. This incorporates all aspects of forage production: variety selection; meeting fertility requirements; proper cutting schedules; weed, disease and insect control.

Choosing a Seed Mixture Success with a seed mixture depends upon the correct selection of the legume and the grass components to suit conditions under which the mixture will be grown. Simple mixtures containing one legume and one or two grasses are recommended as they are more productive than complex ones. Pure sowings of a legume or a grass are recommended under special conditions.

Selection begins with the choice of a legume to suit the intended use, soil drainage conditions, and the duration of stand desired. The suitability of each legume can be determined by reading the information provided about mixtures based on each legume. Once the legume base has been established the specific mixture and the varieties for use in the mixture can be chosen from the recommendations under Alfalfa, Trefoil, White and Red Clover. Grass species and varieties for use in mixtures with legumes or as pure stands of grass are described under grasses. Legumes should be inoculated with the proper strain of viable inoculant.

The species and varieties of grass for use in mixtures with legumes should be chosen on the basis of their maturity. The grass should reach early heading when the legume is ready to harvest, at first flower.

Direct Seeding New forage seedings can be made without a companion crop. A direct seeding is recommended when establishing bird's-foot trefoil, and on those problem fields where forage stands are difficult to obtain. One or two harvests may be available from a direct alfalfa seeding in the seedling year prior to late August, yielding about 50 to 60% of the first production year.

Adequate plant nutrients are essential for good forage seedling development, especially phosphorus. A band seeder attachment on a grain drill places the forage seeds directly over the fertilizer. Band seeding over a fertilizer containing phosphate aids seedling growth where direct seedings are made without a companion crop and on fields where thick vigorous stands are difficult to obtain (see also Fertilizers for Forage Crops page 19).

Coated Seed Coated legume seed usually has one-third fewer seeds per kilogram than the same weight of non-coated or bare seed. Generally coated grass seed has 50% fewer seeds per kilogram. Research has shown that at recommended seeding rates there is no yield difference between equal product weights of bare seed and coated seed. However, with bare seed and early seeding on a fine firm seedbed, recommended seeding rates can be reduced by 25%. Limited research indicates that with coated seed, seeding rates should not be reduced below those listed in the tables.

Coated legume seed is a good system of inoculation. Carry over seed should be reinoculated prior to planting. Coated seed reduces seed treatment dust and some of the hazard associated with handling pesticides.

Some grass species have light seeds and coating aids in controlling flow and distribution at planting time particularly with aerial or broadcast seeding.

Coated seed has advantages, particularly with trefoil, in roughland pasture renovation and/or under adverse establishment conditions.

Coated seed is generally less expensive than bare seed for equal weights of product. However, under normal establishment conditions, growers may find reduced rates of non-coated seed to be more economical.

Harvesting Schedule All forages and, in particular, alfalfa are excellent sources of protein for ruminant livestock.

Feeding trials have demonstrated that forage legumes can supply most if not all of the protein requirements of high producing dairy cows; that faster and more efficient gains are obtained in young beef cattle (400 to 650 lb) when protein from forage rather than inorganic nitrogen is fed. When fed as a supplement, high quality forage legumes do not dilute the energy content of most cattle rations. In addition, protein from this source is low in cost.

In order to supply a concentrated high protein supplement, early cutting and careful handling to reduce leaf loss are essential. Harvesting as soon as the flower buds appear will result in a concentration of from 19 to 23% protein in the forage from alfalfa, bird's-foot trefoil or red clover. Where top production of high quality stored feed is planned, a haylage system works best. Three harvests at an early bud stage of legume development are necessary. The first crop must be harvested by the first week in June.

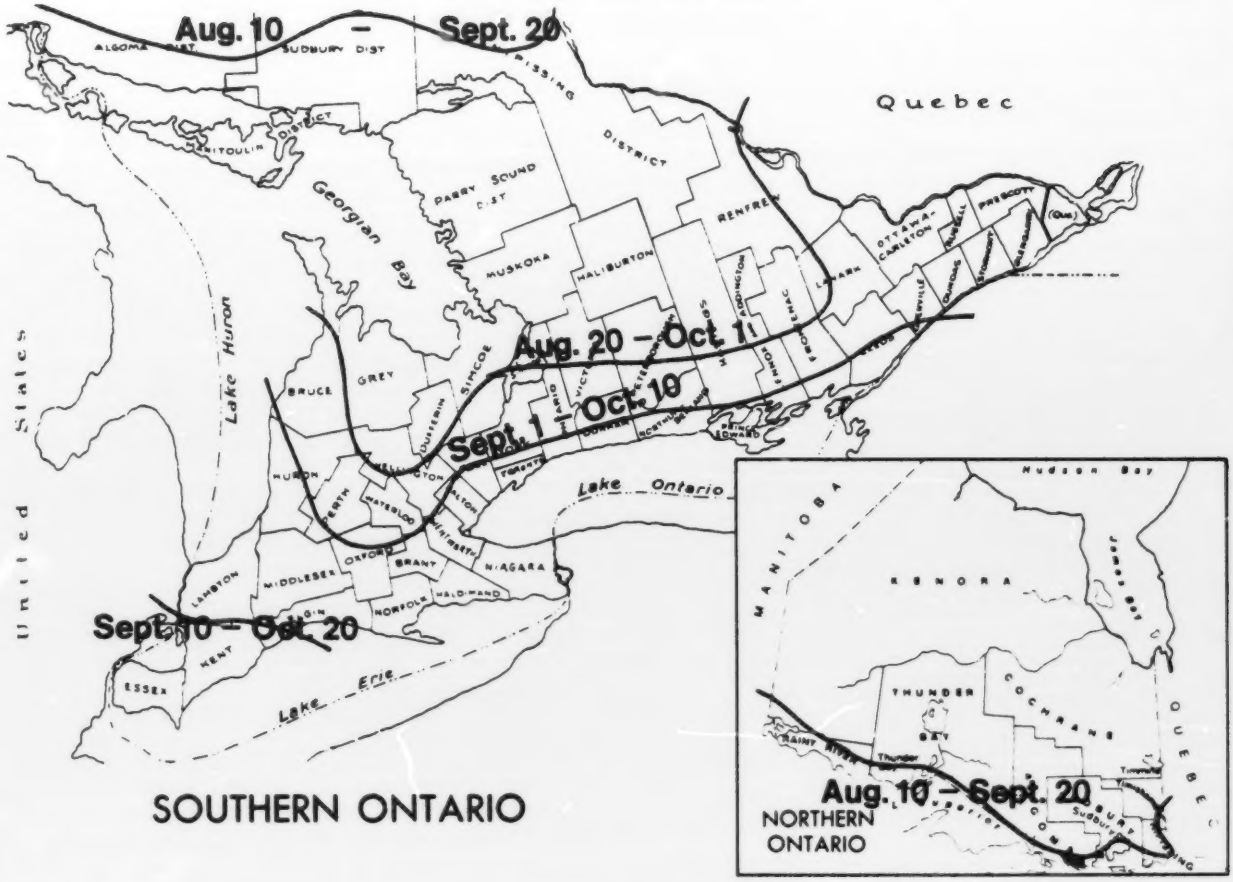
Since grasses contain about half as much protein as the legumes, their inclusion in mixtures will markedly decrease the protein content of stored forages. For example, alfalfa at the first sign of a flower will contain about 18% crude protein. Cut at the same stage but in a mixture with 50% timothy, the protein content of the feed would only be about 14%.

Retention of leaves is important as they contain approximately 70% of the protein in the crop. Leaf loss in harvesting, therefore, must be kept low. The use of mower-conditioners, windrowing at cutting time or when the forage is tough, and/or storing the crop as silage are all practices which help to retain leaves. Legumes also add organic matter and nitrogen (up to 110 kg/ha nitrogen) to the soil when plowed down.

Fall Management Alfalfa, and all other legumes must store food reserves in their roots during the fall to prevent them from killing over winter. Such food makes the plant resistant to low winter temperatures and is used also to initiate new growth in the spring and after each harvest. Each region in the province has a period in the fall when cutting or grazing will weaken plants to the level where they will either winter-kill severely or succeeding yields will be greatly reduced. This period is known as the **Critical Fall Harvest Period** and is shown for Ontario on the map on page 11. In addition, leaving a foot or more of top growth for winter is excellent insurance against winterkilling.

To ensure persistence and succeeding yields, do not harvest alfalfa during the critical harvest period shown on the map for each region.

Critical Fall Harvest Dates for Alfalfa



LEGUMES

ALFALFA

Alfalfa-based mixtures are intended for use in stored-feed and green feeding programs because they produce more hay, silage or green chop than any other mixture. Given good management including adequate phosphorus, potash and proper cutting management, high yields of quality livestock feed will be produced for periods up to four years. When used as pasture, these mixtures are for short-term stands only because alfalfa may thin out in two or three years. For the highest production and best persistence, alfalfa mixtures should be used on well-drained soils. This condition does eliminate the economic use of alfalfa on many heavy clay soil types of the clay belt of northern Ontario.

Both early and medium maturing alfalfa-based mixtures can be used on the farm to permit staggering of the harvest dates. The early maturing varieties develop quickly in the spring and provide more and earlier aftermath than medium maturing varieties.

The medium maturing varieties are recommended for stored feed and pasture mixtures that mature later than those using early varieties. Some of the medium maturing varieties are preferred where drainage is variable, or when a pasture mixture is to be seeded.

CROP MANAGEMENT

1. Alfalfa-based mixtures may be seeded with or without a companion crop. Where high forage yields are required in the seeding year *do not* use a companion crop. Weeds must be controlled. When a companion crop is desired use oats at 60 kg/ha preferably in 36 cm rows. Remove the oat crop when knee-high by controlled grazing or at the early dough stage for stored feed if forage establishment is a problem.
2. For stored feed cut at very first flower stage to obtain high quality feed.
3. For pasture, alfalfa must not be overgrazed. Rotational or strip grazing with four-to five-week rest periods improves the persistence of the stand.
4. High soil levels of phosphorus and potassium are required for high yields and maintenance of the stand. See pages 19, 20 and 21 for fertility recommendations.
5. Alfalfa is particularly sensitive to cutting or grazing during September and October. Succeeding yields and persistence can be severely reduced if harvests occur during the critical fall harvest (see page 11).
6. The life expectancy of alfalfa under favorable field conditions varies from two to five years. Long life can be expected where only two harvests as stored feed are taken annually, but a shorter life span is found where aftermaths of hay meadows are grazed or alfalfa is used in pasture mixtures.

ALFALFA VARIETY SELECTION

Both early and medium type alfalfas are recommended in Ontario. The advantages of the early type are:

1. They flower, and can be harvested, three to five days earlier than the medium type;
2. They provide faster recovering aftermaths and more of it;
3. In the first harvest year, and frequently in the second, they outyield the medium type.

The disadvantage of the early varieties is that some may be somewhat less persistent than the more hardy medium-type alfalfas.

In general, early alfalfas provide rapid regrowth and very good persistence, while medium-type alfalfas provide slower regrowth and excellent persistence.

All recommended varieties are resistant to bacterial wilt. None are resistant to verticillium wilt. There are currently four recommended varieties with some tolerance to phytophthora root rot. For more information on these diseases, see Disease and Insect Control in Forage Crops, page 21.

Alfalfa Varieties Tolerant to Phytophthora Root Rot

Variety	% Plants Resistant to Phytophthora
Answer	66%
Apollo	40%
Trident	71%
120	39%

Recommended Alfalfa-Based Mixtures

Components	Seeding Rate* kg/ha	Use Recommendation
Alfalfa alone	13	Use only on fields where alfalfa is known to do well. High levels of fertility are necessary. Harvest at first flower stage and store as haylage or well-cured hay. For 20% or higher crude protein feed, harvest when the flower buds appear. Use early or medium-maturing varieties.
Alfalfa Bromegrass	11 9	An excellent hay, silage or green chop mixture. Recommended over alfalfa-timothy for farms having more than 3100 heat units and dry soils. Use early or medium-maturing alfalfa varieties.
Alfalfa Timothy	11 6	Use where aftermath is not required as pasture, but where high quality stored feed is the main consideration. Use this high producing mixture as one of a series to diversify the maturity date of mixtures on the farm. Use with medium maturing alfalfa.
Alfalfa Orchard	11 6	Use on part of acreage where cutting and/or grazing can be matched with maturity of the varieties used. This early maturing mixture demands early cutting for high digestibility and to best utilize the rapid recovery and high aftermath yield. Use early varieties only. Where ladino is adapted, 0.5 kg ladino can be added.
Alfalfa Ladino Timothy Bromegrass	9 2 4 9	For use as part of the pasture acreage and where hay aftermath is to be grazed. Use in combination with mixtures containing orchard to help the pasture production period.
Alfalfa Ladino Orchard Bromegrass	9 2 3 9	Use in conjunction with above mixture to spread pasture production. Alfalfa, orchard, and brome give good production under dry conditions.
Alfalfa Ladino Orchard	9 2 9	For use under pasture or hay-pasture conditions. High fertility and good management are necessary for top production. Alfalfa is included as insurance against dry conditions. See white clover-orchard mixtures on page 15.

** For early seeding on a fine, firm seedbed, these rates may be reduced by 25% except where coated seed is being used. On farms where these mixtures result in stands with too much grass, reduce the grass seeding rate by up to 50%.*

Recommended Alfalfa Varieties

Variety	Distributor*	Variety	Distributor*
EARLY ALFALFA		**MEDIUM ALFALFA**	
Anchor	OSECO Inc.	Algonquin	Public variety
Angus	Public variety	120	Dekalb Canada
Answer	Speare Seeds	Iroquois	Public variety
Apollo	OSECO Inc., PAG Seeds	Magnum	Mapleseed Inc.
Banner	Pioneer Hi-Bred	Pickstar	Otto Pick & Sons Seeds
Ceres	King Grain, Speare, OSECO Inc.	520	Pioneer Hi-Bred
Citation	Mapleseed Inc.	524	Pioneer Hi-Bred
Classic	United Co-ops of Ontario	Titan	OSECO Inc.
130	Dekalb Canada	Valor	OSECO Inc.
Pacer	Bishop Seeds, OSECO Inc.,	Vernal	Public variety
532	General Seed Co.	WL215	King Grain, Speare, OSECO Inc.
Primal	Pioneer Hi-Bred	Weevlchek	United Co-ops of Ontario
Saranac	King Grain		
Thor	Public variety		
Trident	Northrup King Seeds		
Vista	PAG Seeds		
	Otto Pick & Sons Seeds		

* *Distributor addresses are listed on page 58.*

Early Alfalfa Variety Yields

Yield (as % of Saranac)

Variety	Southern Ontario	Northern Ontario
	%	%
Saranac	100	100
Anchor	99	97
Angus	99	101
Answer	98	94
Apollo	98	93
Banner	103	101
Ceres	100	94
Citation	104	101
Classic	100	104
130	102	102
Pacer	99	96
532	104	101
Primal	101	99
Thor	100	99
Trident	99	99
Vista	99	98

Average yield of Saranac in southern Ontario trials 12.2 t/ha; in northern Ontario trials 7.2 t/ha.

Medium Alfalfa Variety Yields

Yield (as % of 520)

Variety	Southern Ontario	Northern Ontario
	%	%
520	100	100
Algonquin	97	101
120	103	100
Iroquois	100	103
Magnum	98	94
Pickstar	98	99
524	103	99
Titan	97	106
Valor	99	103
Vernal	98	103
WL215	97	96
Weevlchek	99	91

Average yield of 520 in southern Ontario trials 12.3 t/ha; in northern Ontario trials, 6.6 t/ha.

BIRD'S-FOOT TREFOIL

Under good fertility and well-drained conditions, established trefoil annually produces less forage than alfalfa.

However, trefoil stands have been known to be productive for 20 years. The no-bloat feature makes trefoil an excellent long-term pasture legume.

Trefoil-based mixtures can be used in pasture, stored feed or green chop programs. They should be used only for stands of three or more years duration.

Trefoil-based mixtures perform and persist very well on steep, rolling or stoney land, or under wet or acid conditions.

Management

1. Where normal tillage equipment can be used to prepare a seedbed and establish trefoil using the direct seeding method, seed early in spring, do not use a companion crop, control weeds and apply up to 15 kg/ha of nitrogen with the necessary phosphate and potash. (See Fertilizers for Hay and Pasture, pages 19 and 20.) Inoculate trefoil with the proper viable inoculant.

2. For hay or silage, harvest at the early flower stage of growth.
3. For pasture do not graze until trefoil is 25 to 30 cm high in the spring, except in northern Ontario, where grazing can begin when trefoil is 15 to 20 cm high. For best results use rotational rather than continuous grazing.
4. Trefoil is as sensitive as alfalfa to fall grazings or harvests. Succeeding year's yields are reduced if heavy grazing or harvesting occurs during the critical fall period. (See map, page 11.)
5. Trefoil stands often require one year following the seedling year to reach maximum productivity. This is particularly true when trefoil is seeded under a companion crop.

Bird's-Foot Trefoil Variety Selection

Four varieties are now recommended in Ontario. These varieties differ in their ability to withstand flooding and poor drainage. They also differ in seedling vigor, growth habit, maturity and hardiness. Differences in yield potential are small and are less significant in variety selections than are differences in drainage tolerance and maturity.

RED CLOVER

Red clover-based mixtures are short-term mixtures best used for stored-feed production. Red clover produces well in the year following seeding, but usually thins severely by the second harvest year. Timothy is the best grass to use with red clover.

This mixture can be made into a good stored feed or a combination feed and seed crop. Do not use red clover in pasture mixtures.

Inoculated red clover makes an excellent green-manure or plow-down crop. It is easy to establish and can be frost-seeded in March on winter wheat or later under spring

Recommended Bird's-Foot Trefoil Varieties*

Variety	First Flower (Guelph)	First Flower (Kapuskasing)	Major Use	Regrowth	Variable Drainage Tolerance	Hardiness	Distributor
Viking	June 15	June 25	Hay	Med	Fair	Good	Public variety
Maitland	June 16	June 27	Hay	Med	Fair	Good	Companies listed below**
Leo	June 23	June 30	Pasture or hay	Med	Excellent	Excellent	Public variety
Empire	July 1	July 7	Pasture or hay	Slow	Excellent	Excellent	Public variety

* *Distributor addresses are listed on page 58.*
** *Mapleseed Inc., OSECO Inc., and Otto Pick & Sons Seeds.*

Bird's-Foot Trefoil Variety Yields

Variety	Yield (as % of Leo) Southern Ontario	Northern Ontario
	%	%
Leo	100	100
Empire	97	98
Maitland	98	97
Viking	96	96

Average yield of Leo in southern Ontario trials 8.5 t/ha; in northern Ontario trials, 6.2 t/ha.

Recommended Bird's-Foot Trefoil-Based Mixtures

Components	Seeding Rate* kg/ha	Expected Life (years)	Use Recommendation
Trefoil Timothy	9 2	5+	For long-term pastures, early or late maturing hay. Free from bloat. Choose varieties for desired maturity and drainage conditions.
Trefoil alone	11	5+	For renovating or overseeding pastures. For high protein stored feed cut at the late bud stage but it may not last five years. Direct seedings preferred.
Trefoil Bromegrass	9 5	5+	Graze early to reduce brome competition. Take hay from regrowth only. Fall growth may be pastured.

* *For early seeding on a fine, firm seedbed, these rates may be reduced by 25% except where coated seed is being used.*

grains. Seeded under an early removed grain companion crop, double-cut red clover will produce, by late fall in favorable years, about 2 t of top growth plus 2 t of roots per ha to a 20 cm plow depth, on a dry matter basis. If direct seeded, these fall yields will be increased about 30%. This is in addition to a 4 t hay crop in late July. Top and root material will average about 3% N of which two thirds may be available to the succeeding crop.

Management

1. Harvest for stored feed at early bloom if top quality feed or a seed crop is expected from aftermath.
2. Recommended for short-term stands only.

Red Clover Types Double-cut or medium red clover is the most popular type with farmers. It will flower in the seeding year and in the first and second cut in the succeeding years. The regrowth after cutting is strong and vigorous.

Single-cut or mammoth red clover is slower growing with larger stems and matures about two weeks later than the double-cut. It does not flower in the seeding year or in the slow growing, low yielding leafy aftermath in succeeding years.

Red Clover Variety Selection

The recommended double-cut varieties of red clover are somewhat more persistent in the second production year than is commercial Canadian double-cut, and are recommended where stands will be harvested for two years.

WHITE CLOVER

White clover mixtures perform best as pastures, particularly in areas where moisture is plentiful and winterkilling is not a

Recommended Double-Cut Red Clover Varieties

Variety	First Flower (Guelph)	First Flower (Kapuskasing)	Regrowth	Variable Drainage Tolerance	Distributor*
Arlington	June 15	June 29	Med	Good	Public
Florex	June 18	July 2	Med	Good	Northrup King Seeds Otto Pick & Sons Seeds
Lakeland	June 18	July 2	Med	Good	Public variety
Ottawa	June 18	June 29	Med	Good	Public variety
Prosper I	June 18	July 2	Med	Good	King Grain

* *Distributor addresses are listed on page 58.*

Red Clover Variety Yields

Variety	Yield (as % of Florex) Southern Ontario	Northern Ontario
	%	%
Ottawa	94	91
Arlington	99	95
Florex	100	100
Lakeland	88	96
Prosper I	99	101

Average yield of Florex in southern Ontario trials 9.3 t/ha; in northern Ontario trials 5.2 t/ha.

Recommended Red Clover-Based Mixtures

Components	Seeding Rate* kg/ha	Expected Life (years)	Use Recommendation
Red Clover Alsike Timothy	7 2 6	1 to 2	For short-term hay. Less clover can be expected in the second year. When clover disappears, plow. Fertilize with nitrogen in order to maintain production only when necessary.
Red Clover Timothy	7 6	1 to 2	For short-term stands of hay. When clover disappears, plow. Fertilize with nitrogen in order to maintain production only when necessary.
Red Clover	11	1	Short-term hay, seed and/or green-manure crop. Plow in the seeding or after the first production year. Follow with corn, a row crop or winter wheat.

* *For early seeding on a fine, firm seedbed, these rates may be reduced by 25% except where coated seed is being used.*

Recommended White Clover-Based Mixtures

Components	Seeding Rate* kg/ha	Expected Life (years)	Use Recommendation
White clover (Ladino type)	2	3	For pasture use where white clover is adapted. White clover and orchard grass grow best when moisture and winter-killing are not problems. High fertility and good management required for top production. In dry areas add 9 kg alfalfa. See alfalfa ladino orchard mixture on page 12.
Orchard	9		

** For early seeding on a fine, firm seedbed, these rates may be reduced by 25% except where coated seed is being used.*

problem. They are difficult to cure as hay. Ladino is the large tall-growing type of white clover, and is the type of white clover recommended in Ontario. It tolerates variable drainage conditions. Because it flowers in early June and regrows rapidly, it performs well in combinations with orchard grass to give an early maturing mixture. Including an early productive grass such as orchard grass in a white clover based pasture mixture can help to reduce the bloat hazard.

Management

1. Control grazing in autumn to leave protective cover of grass leaves on overwintering creeping stems of ladino.
2. Controlled grazing management helps the stand remain productive for a period of years.

GRASSES

Generally, legume grass mixtures are more productive than grasses grown alone. However, pure grass stands may be more productive than legumes on poorly drained soils, under acid soil conditions, or under climatic or management conditions unfavorable to legumes.

Orchard grass, bromegrass, timothy and mixtures of these can be used in areas where early pasture is required.

Cut at the heads emerging stage for stored feed, grasses are as high in digestible energy as legumes. If fertilized properly with nitrogen their crude protein content may range from 12 to 15%. Reed canary grass should be used on very poorly drained areas when long-term stands are desired. All grass stands require nitrogen, phosphate and potash to be productive. (See pages 19 to 21 fertilizers for forage crops.)

Management

1. Successful seeding of pure grass can best be obtained by seeding in early spring. Seeding after midsummer reduces the chance for successful establishment. Use a complete fertilizer (Nitrogen, Phosphate and Potash) at seeding time.
2. Harvest grasses at the "heads just emerged" stage of growth for top quality stored feed.
3. Apply recommended rates of nitrogen early each spring and after each cutting or grazing.
4. Apply phosphate and potash each fall at rates indicated by soil test or follow recommendations on page 20 and 21.

Recommended Pure Grass Seeding Rates

Pure Stand of	Seeding Rate kg/ha
Reed Canary	9
Brome	11
Timothy	9
Orchard	9

BROMEGRASS

This grass species is important for early and late cut hay. Harvested at the recommended "heads emerged" stage, it is higher in digestibility but much earlier maturing than timothy. As bromegrass advances in maturity, its digestibility decreases at a slower rate than other grasses. Bromegrass produces slightly more aftermath than timothy and combines well with alfalfa in legume-grass mixtures.

For early pasture bromegrass is excellent. Used in mixtures it permits early grazing in the spring and good growth in the fall.

ORCHARD GRASS

This grass is an early maturing forage that grows rapidly under a high nitrogen fertilization program. It is cut for stored feed when the heads are just emerging from the boot. The early varieties are adapted to silage and pasture mixtures, whereas the later varieties will combine better with alfalfa for hay or hay-pasture mixtures.

Orchard grass grows back rapidly after cutting or grazing. It is our best grass for aftermath production during the hot, drier summer period. It will reduce the bloating effect of alfalfa and the clovers when grown in mixtures. For pasture, the maturing stems and heads should be clipped in late May or in early June to maintain a leafy, palatable growth.

Orchard grass requires well-drained soils to perform adequately. Surface drainage is necessary as ice conditions or flooding will kill orchard grass.

TIMOTHY

The basic meadow grass in Ontario — timothy — grows under a wider range of environments than any other grass used, and is easy to establish and maintain. Alfalfa-timothy mixtures are among the most popular and productive mixtures for stored feed. It is well adapted to the heavier soil types and variably drained fields. Cut for hay at the heading stage, timothy is a high-yielding quality grass. Like all grasses, in a mixture it contains about half the crude protein of alfalfa. For pasture or hay aftermath, timothy is a lower producer than orchard or brome. Palatable and high-yielding in the spring, it grows back slowly after cutting

or grazing, and most varieties produce relatively poor growth during the dry midsummer. However, since timothy adds stand insurance, small to moderate amounts are useful when making new seedlings with legumes.

REED CANARY GRASS

This grass species tolerates excessive moisture and is highly productive for long-term hay or pasture on poorly drained soils, or areas subject to prolonged periods of flooding. It is also adapted to dry upland soils. Reed canary grass is less palatable than other grasses and, if allowed to mature, is tall and coarse. When grazed heavily enough to prevent heading, reed canary grass is a good pasture producer.

For stored feed reed canary grass is more acceptable to livestock when stored as silage or haylage, rather than dry hay, due to its coarse growth habit.

THE BLUEGRASSES

Two common bluegrasses in Ontario, Canada and Kentucky, grow on about one million hectares of permanent pasture land. Much of this pasture is low in production but can be improved by renovation, fertilization and weed control. The dense but shallow rooted bluegrasses produce lush, palatable growth during the springtime but low yields during the dry, hot midsummer in southern Ontario. Properly fertilized and managed, their production can be markedly improved, especially in the cooler climate of northern Ontario. In horse pastures, they serve as a bottom grass that inhibits weed invasion, withstands close grazing and tramping, and creeps and fills in where other species thin out.

CREEPING RED FESCUE

Creeping red fescue establishes well on a wide range of soil types and will establish plants also on well-fertilized subsoil. It spreads vigorously on ditch banks with a solid underground root system. Such roots hold the soil from underneath while the thick, fine, leafy top growth protects the soil surface against water movement. These characteristics, plus its low growth, make it very useful for stabilizing ditch and creek bank soils.

TALL FESCUE

Tall fescue is not readily grazed by livestock during much of the year, consequently, it provides substantial amounts of coarse, leafy, top growth in paddocks and loafing areas. It is adapted to most soil types, tolerant to imperfect drainage, and has the ability to withstand considerable tramping because it has an extensive and vigorous root system. It grows well throughout the year, particularly in the fall when its palatability generally improves.

Recommended Grass Varieties

Variety	Heading Date (Guelph)	Heading Date (Kapuskasing)	Aftermath Production	Tolerance to Variable Drainage	Distributor*
Bromegrass					
Baylor	June 10	June 26	Good	Fair	OSECO Inc.
Beacon	June 10	June 25	Good	Fair	OSECO Inc.
Blair	June 10	June 24	Good	Fair	Mapleseed Inc.
Bromex	June 10	June 26	Good	Fair	Northrup King Seeds
Saratoga	June 10	June 24	Good	Fair	Public
Tempo	June 10	June 24	Good	Fair	Public variety
Orchard Grass					
Hallmark	June 2	June 15	Excellent	Poor	United Co-ops of Ontario
Juno	June 2	June 15	Excellent	Poor	Otto Pick & Sons Seeds
Ina	June 8	June 15	Excellent	Poor	Otto Pick & Sons Seeds
Napier	June 8	June 16	Excellent	Poor	OSECO Inc.
Orion	June 16	June 20	Excellent	Poor	Northrup King Seeds
Sumas	June 12	June 18	Excellent	Poor	OSECO Inc.
Kay	June 12	June 18	Excellent	Poor	OSECO Inc.
Timothy					
Salvo	June 16	June 22	Good	Good	Public SeCan
Toro	June 20	July 3	Good	Good	OSECO Inc.
Basho	June 22	July 2	Good	Good	Public
Richmond	June 22	July 2	Fair	Good	Mapleseed Inc.
Champ	June 23	July 1	Good	Good	Public
Itasca	June 25	July 3	Fair	Good	United Co-ops of Ontario
Timfor	June 28	July 3	Fair	Good	Northrup King Seeds
Climax	June 28	July 5	Fair	Good	Public
Pronto	July 1	July 3	Fair	Good	King Grain
Reed Canary Grass					
Frontier	June 10	June 24	Excellent	Excellent	Public
Rise	June 10	June 24	Excellent	Excellent	OSECO Inc.
Vantage	June 10	June 24	Excellent	Excellent	OSECO Inc.

* *Distributor addresses are listed on page 58.*

Timothy Variety Yields

Variety	Yield (as % of Climax) Southern Ontario	Northern Ontario
	%	%
Climax	100	100
Basho	100	102
Champ	98	106
Itasca	101	106
Pronto	96	104
Richmond	99	99
Salvo	101	101
Timfor	103	104
Toro	99	102

Average yield of Climax, southern Ontario trials 10.0 t/ha; in northern Ontario trials 6.0 t/ha.

Orchard Grass Variety Yields

Variety	Yield (as % of Hallmark) Southern Ontario	Northern Ontario
	%	%
Hallmark	100	100
Ina	97	96
Juno	97	99
Kay	97	105
Napier	98	91
Orion	98	104
Sumas	100	104

Average yield of Hallmark in southern Ontario trials 9.5 t/ha; in northern Ontario trials 6.1 t/ha.

Bromegrass Variety Yields

Variety	Yield (as % of Baylor) Southern Ontario	Northern Ontario
	%	%
Baylor	100	100
Beacon	100	104
Blair	99	—
Bromex	97	97
Saratoga	99	94
Tempo	96	103

Average yield of Baylor in southern Ontario trials 10.1 t/ha; in northern Ontario trials 8.6 t/ha.

Reed Canary Grass Variety Yields

Variety	Yield (as % of Frontier) Southern Ontario	Northern Ontario
	%	%
Frontier	100	100
Rise	98	93
Vantage	102	93

Average yield of Frontier in southern Ontario trials 11.1 t/ha; in northern Ontario trials 7.5 t/ha.

ANNUAL CROPS FOR FORAGE

SPRING PASTURE

Autumn-seeded fall rye seeded at 150 kg/ha can be grazed for a short period in the spring, preferably after the stems start to form. Keep stock off when wet. Another pasture or green chop crop (e.g. corn or sorghums) may follow the rye for summer feed in intensive programs.

SUMMER GREEN CHOP OR PASTURE

Corn Use hybrid seed at normal rates for standard row-widths, or grain corn from the crib if germination is satisfactory for solid-stand grain drill plantings. In the latter case, 70 kg of seed per hectare is adequate for 18 cm drills. Early planting is preferred. No aftermath can be expected. Use for green chop. Harvest should commence at about tasselling time.

Sudan-Sorghum Hybrids Seed from mid-May to early June at about 14 kg/ha in 18 or 36 cm drill rows. The crop is ready for green chop or grazing by late July-August. Do not graze before 75 cm high or during severe stress as **prussic acid poisoning** could occur. If frozen, allow three days following frost before grazing again to avoid prussic acid poisoning. Aftermath yields are moderate but high if warm moist weather prevails. Under good nitrogen fertility, these crops can produce large quantities of nutritious, palatable herbage. They are particularly useful on dairy farms to supplement normal pastures during August and September.

Sudan-sorghum hybrids are not recommended in short season areas because of inconsistent yields and danger of prussic acid poisoning.

Oats Seed any time in the season to produce pasture in six to eight weeks. Seed at 100 kg/ha. Graze when stems are forming. No aftermath can be expected.

AUTUMN PASTURE

Oats Seeded at 100 kg/ha between mid-July and August 15, ready for grazing in six weeks.

Fodder rape Seed in early July at 1.7 kg/ha in 71 cm rows. May be seeded in solid stands, but yields are 25% lower. Pasture in late October. Makes good hog, sheep, or beef pasture. Taints milk.

Marrowstem kale Seed by early June on clean fields well supplied with nitrogen (85 kg/ha). Solid seedings at 7 kg/ha give good yields for grazing in August and September; 71 cm row seedings for grazing in October and November. Kale is palatable to all classes of livestock. Moderate intakes will not produce off-flavors in milk. The varieties **Maris Kestrel** and **Gruner Angelites** are recommended.

Fall rye Seeded by August 1, at 150 kg/ha, gives good fall pasture by October 1.

SILAGE CROPS

Any of the annual forages can be made into silage. The immature crop has lower yields than the mature crop. Corn is the most important silage crop.

Special Purpose Mixtures

Use	Components	Seeding Rate kg per hectare	Comments
Horse Pasture	Alfalfa	9	Early spring seeding is preferred. For more information see OMAF Factsheet, *Hay and Pasture for Horses*, Agdex 460/10.
	White Clover	2	
	Timothy	5	
	Bromegrass	9	
	Kentucky bluegrass	5	
Horse Paddock and Dairy Holding Area	Tall Fescue	14	Early spring seeding is preferred. For exercise area only. Clip if necessary.
Ditch banks	Trefoil (Empire Type)	13	Early spring seeding is preferred. Apply 2 cm of straw as a mulch.
	Creeping Red Fescue	20	
Waterways	Any of the Alfalfa or Trefoil based mixtures (pages 12 and 14)		These mixtures can be used and harvested for stored-feed where standing water is not a problem and the slope not too severe, otherwise the Trefoil-Fescue mixture mentioned above should be used.

FERTILIZERS FOR FORAGE CROPS

Fertilizer requirements for forages in Ontario can best be estimated by using a soil test along with information on the species growth and past management such as manure. Fertilizer recommendations are based on the results of trials run on research stations and farm fields in Ontario. The recommendations in this publication can be expected to produce highest economic returns from the crop when good or above average management is used.

To provide dependable fertilizer recommendations each field should be tested at least once every third year. When large amounts of nutrients are removed from sandy soils (with crops such as hay, corn silage, potatoes or tomatoes) and manure is not applied, annual testing is advisable as potash soil tests can change rapidly under those conditions.

Where a soil test is not available, a rough estimate of requirements can be obtained from the tables on pages 20 and 21 using the following guidelines:

(a) Where the field has been fertilized regularly for a number of years or heavily in recent years, use one of the rates of phosphate and potash recommended for the MEDIUM soil test rating (see tables on pages 20 and 21).

(b) If the field has received little fertilizer in the past, use one of the rates recommended for a LOW soil test rating (see tables on pages 20 and 21).

Nitrogen

No soil test is available which is satisfactory for nitrogen under Ontario conditions. Nitrogen fertilizer recommendations are therefore based on the crop and adjusted down-

Nitrogen Requirement Table for Improved Grass Hay or Pasture

Value of Grass		Application	Cost of Nitrogen Fertilizer — ¢/kg (c/lb)			
Hay @ 15% Moisture		No.	60 (27.2)	70 (31.7)	80 (36.3)	90 (40.8)
$/tonne	($/ton)		(kg N/ha)*			
30.00	(27.22)	1	95	75	60	45
		2	75	60	50	35
		3	60	50	40	30
50.00	(45.36)	1	130	125	115	105
		2	105	100	90	80
		3	85	80	70	65
70.00	(63.50)	1	150	140	135	130
		2	120	115	110	100
		3	95	90	85	80

10 tonne = 11 ton, 100 kg/ha = 90 lb/ac.

* *All rates should be reduced by one third where the crop is to be harvested by grazing because of recycling through manure and urine. Where manure is applied to machine harvested forage, reduce the fertilizer application according to the amount and quality of manure (see page 42).*

** *1. First application to be made prior to May 10.*
2. Second application to be made after the first cut.
3. Third application to be made after the second cut only if there is reasonable assurance of a third cut.

General Nitrogen Requirements — Perennial Forages

Crops	N Required kg/ha*
Legume or legume-grass at seeding — with or without companion crop	15
Unimproved pasture	50
Grass for seed	90
Hay or pasture — 1/2 or more legume	0
Hay or pasture — 1/3 to 1/2 legume	60
Hay or pasture — grass (less than 1/3 legume)	(See table below.)

** 100 kg/ha = 90 lb/ac.*

ward if manure is applied. Stands containing half or more legume do not require nitrogen fertilizers.

Grass stands containing less than one-third legume require large amounts of nitrogen. Where conditions permit, therefore, it is generally more profitable to reseed to mixtures containing legumes. It can be profitable, however, to fertilize grass stands consisting of productive species such as brome, orchard, or timothy. The use of nitrogen will also increase the protein level in the grass. The rates of nitrogen recommended for grass stands have been developed on the basis of the price of nitrogen relative to the value of hay (see table on page 19). The first application for hay or pasture should be made as early as possible in the spring, followed by a second application after the first cutting and a third application after the second cutting. To avoid the danger of nitrate toxicity no more than 170 kg of N per ha should be applied at any one time. It rarely pays to fertilize old bluegrass pasture with more than 50 kg of N per ha.

Phosphate and Potash

Phosphate and potash requirements for forages are presented in the tables on pages 20 and 21. These recommendations are based on soil tests conducted by the Ontario Ministry of Agriculture and Food soil testing laboratory at the Department of Land Resource Science, University of Guelph. These tables should not be used with soil test readings from other soil testing laboratories unless the methods used are identical to those used in the OMAF laboratory.

Some clay and clay loam soils are naturally high in potassium and do not require any potash fertilizers. Only a soil test can adequately determine potash requirements.

When direct seeding on soils which require phosphate fertilizer, establishment may be improved by the placement of a high phosphate fertilizer 5 cm directly below the seed. Using a grain drill with fertilizer and grass seed attachments, this placement may be accomplished by drilling the fertilizer through the furrow opener and dropping the forage seed on a firm soil surface directly behind the furrow opener. Usually it is advisable to firm the soil surface immediately after seeding.

The timing of fertilizer application to established forage stands may influence the response obtained. Potassium, where required, is best applied after the last harvest prior to the fall rest period (see page 11). Phosphorus, if required, may be applied with the potassium in the fall or applied separately in the spring or summer.

Manure

Manure is an excellent source of nutrients and can substitute for manufactured fertilizers. It is an excellent source of nitrogen for grasses but forage legumes do not make efficient

Phosphate Requirements for Forages Based on OMAF Soil Tests

	At seeding with or without nurse crop		Forages at seeding — band seeded*		Established hay or pasture		Unimproved pasture	
Phosphorus Soil Test	Soil Test Rating	P_2O_5** Required kg/ha	Soil Test Rating	P_2O_5** Required kg/ha	Soil Test Rating	P_2O_5** Required kg/ha	Soil Test Rating	P_2O_5** Required kg/ha
0 — 3		130		130		90		70
4 — 5		110		110		70		60
6 — 7	LOW	90	LOW	90	LOW	60	LOW	50
8 — 9		70		70		50		30
10 — 12		50		50		30		20
13 — 15		30		40	MEDIUM	20	MEDIUM	20
16 — 20	MEDIUM	20	MEDIUM	30		0		0
21 — 25		20		20	HIGH	0		0
26 — 30		0		20		0	HIGH	0
31 — 40	HIGH	0	HIGH	20		0		0
41 — 50		0		20	VERY HIGH	0		0
51 — 60	VERY HIGH	0	VERY HIGH	0		0	VERY HIGH	0
60+	EXCESSIVE***	0	EXCESSIVE***	0	EXCESSIVE***	0	EXCESSIVE***	0

100 kg/ha = 90 lb/ac

** For use only where seed is banded directly above the drilled fertilizer.*

*** Where manure is applied, reduce the fertilizer application according to the amount and quality of manure (see page 42). Examples of fertilizer application: An established stand of hay containing over 50% alfalfa would require no nitrogen (see table above). If it were not manured and the soil tests were 14 phosphorus and 65 for potassium, the phosphate requirement would be 20 kg/ha (from above table) and the potash requirement 70 kg/ha (table on page 20). This could be supplied by broadcasting 45 kg/ha (20 ÷ 46 x 100) of 0-46-0 and 120 kg/ha (70 ÷ 60 x 100) of 0-0-60 prior to the fall rest period.*

**** Excessive readings may cause reduced yield or affect nutrient balance in crops and increase the risk of water pollution.*

Potash Requirements for Forages Based on OMAF Soil Tests

Potassium Soil Test	At seeding with or without nurse crop: Soil Test Rating	At seeding with or without nurse crop: Potash (K_2O)* Required — kg/ha	Fall applications for new seeding and established stands: Soil Test Rating	Fall applications for new seeding and established stands: Potash (K_2O)* Required — kg/ha
0 — 15		90		250
16 — 30		80		220
31 — 45	LOW	70	LOW	190
46 — 60		50		160
61 — 80		40		120
81 — 100		30		90
101 — 120	MEDIUM	20	MEDIUM	70
121 — 150		20		40
151 — 180	HIGH	0	HIGH	0
181 — 250	VERY HIGH	0	VERY HIGH	0
250+	EXCESSIVE**	0	EXCESSIVE**	0

100 kg/ha = 90 lb/ac

** Where manure is applied, reduce the fertilizer according to the amount and quality of manure (see page 42).*

*** Excessive ratings may cause reduced yield or quality of crops primarily due to magnesium deficiency. Natural levels above 250 occur occasionally on clay and clay loam soils, but are not expected to cause problems because soils naturally high in potassium are usually high in magnesium.*

use of manure nitrogen. Do not apply manure to perennial forage legumes when there is snow cover because ice frequently forms under the manure and can kill the plants (also see page 42).

Liming

Legumes generally are not tolerant of acid soil conditions. Acid soils (pH 6.0 or lower) should be limed one year before seeding, at rates indicated by soil tests.

Boron

Boron is a micronutrient which is particularly important for alfalfa. However, boron fertilizer applications are not required on all soils. In Ontario, boron deficiency of alfalfa shows up mainly on high pH sandy soils. In particular, the sandy loam and loam soils in the area east of the Niagara Escarpment to and including Frontenac County frequently require boron applications.

A shortage of available boron to the alfalfa plant first affects flowering and reduces seed-set. As the deficiency becomes more serious, the youngest upper leaves of the plant become a bright yellow to a red color in different plants. Growth can be severely stunted and winter hardiness reduced.

Boron deficiency can usually be corrected or prevented by an application of 2.0 to 3.5 kg boron/hectare applied every second year.

For further details on boron deficiency and on methods of application see Factsheet, *Boron Requirements of Alfalfa*, Agdex 121/531.

DISEASE AND INSECT CONTROL IN FORAGE CROPS

(See also pages 48 to 53)

DISEASES

Phytophthora root rot is a soil-borne disease which can result in root injury or death of alfalfa plants. Young plants in new seedings are particularly prone to damage. The disease shows up in Ontario mainly on poorly drained soils or on clay loam soils during extended periods of wet weather.

Consult the section **Alfalfa Variety Selection** on page 12 for a list of recommended varieties with some resistance to this disease.

Verticillium Wilt has been found in several fields in Ontario. The disease is serious, however, in western seed-producing areas. To prevent introduction of Verticillium with seed, all alfalfa seed offered for sale will be treated with a recommended fungicide. No recommended varieties of alfalfa are resistant. The disease can be spread from field to field by machinery.

INSECTS

Armyworm Maintain a close watch for outbreaks in grasses in late June and July. If they become destructive, control them as indicated on page 31 under Cereal Crops.

Cereal Leaf Beetle Refer to quarantine regulations under Cereal Crops page 31 concerning movement of hay.

Alfalfa Weevil Generally the alfalfa weevil has declined in importance across Ontario in recent years. However, farmers should check their fields carefully because populations can change in any area from year to year. For instance, the population increased in the Niagara Peninsula in 1980 and 1981.

The larvae cause most of the damage. They hatch from eggs deposited in the stems and crawl to the tops of alfalfa where they feed on the developing leaf and flower buds. In heavy infestations, they shred the leaves so badly that fields take on a grayish-white or frosted appearance. Experience in Ontario has shown that the peak of larval attack coincides with the bud stage of the first crop. When threatening infestations occur, fields should be cut immediately to eliminate feeding damage. This is also the best time to cut the crop for maximum yield of protein.

The key to weevil control is proper timing of harvest and treatment based on field inspection. Examine each field twice a week from mid-May to June. Check several areas

throughout the field. Look for damage to show up first on shallow soils or on southerly slopes.

1. *First Cut* If 25% of the stems have feeding damage in the tips, cut and remove from fields as soon as possible. If it is not possible to cut the crop immediately, treat with an insecticide as recommended in the following table. For a field inspection system that will detect economic infestations prior to appearance to tip damage, see OMAF Factsheet, *Early Warning System for Alfalfa Weevil Management*, Agdex 121/622.

Fungus disease and several species of parasites are now established in Ontario which help to control the weevil; insecticides hinder their buildup. As a rule, forage stands with less than 50% alfalfa do not warrant insecticidal treatment.

It is a good idea to leave a strip of alfalfa untreated and uncut as a refuge for disease and parasite survival.

2. *Second Cut* If damage was serious on first cut, larval feeding may continue and early regrowth should be carefully checked. If feeding retards regrowth, apply an insecticide. Unnecessary spraying at this time will curtail spread of the beneficial fungus.

Occasionally there is adult feeding on newly emerging shoots. This problem can arise if there is a large population of weevils on the alfalfa and they mature to adults because of late cutting. Even when this happens the adults usually disperse without problems. but if it is cool and wet, then the dispersal out of the fields will be delayed. If injury by the adults is expected, check around the crowns of the plants and if adults are found, spray with either Furadan or Imidan as recommended in the table for weevil control.

See page 49 for information on spray equipment, the proper use of pesticide, and time interval between treatment and harvest or grazing to prevent residue problems.

Alfalfa Weevil Control

Insecticide	Insecticide Formulation*	Product per ha	Days to Cutting or Grazing
[2]Furadan	4.8 F	285 mL	7
Imidan	50% WP	2.2 kg	7
malathion	50% EC	2-2.7 L	7
	is less effective below 16°C		
methoxychlor	2.4 EC	5.5 L	7
	50% WP	2.2 kg	

[2] *Minimum period before reentry into treated areas is 48 hours.*

* *EC (Emulsifiable Concentrate); F (Flowable); WP (Wettable Powder).*

CAUTION: See the warning PROTECT HONEYBEES on page 49. When planning to appy a pesticide, advise local beekeepers so that they have an opportunity to move colonies out of the danger area. Your local agricultural representative has a listing of the beekeepers in your area.

European Skipper This is an occasional but important pest of timothy, both in hay and seed production. The adult is an orange butterfly with a 2.5 cm wing spread. It congregates in damp places and skips about hay fields in midsummer. The larvae are light green, up to 2.5 cm long, caterpillars, usually found within rolled leaves where they feed. Leaf margins become irregularly notched and when abundant they defoliate timothy.

Fields must be checked for the caterpillars by late April or early May. Initially, the small caterpillars have black heads but soon become a brown color with two light bands. If six caterpillars in an area 30 cm x 30 cm are found as early as the brown headed stage, treat the field or the infested area. Use either Thuricide HPC at 2.25 L/ha or Dipel (SC) at 0.3-0.6 kg/ha. Note that these insecticides will not immediately kill the caterpillars, however, they will stop feeding.

Grasshoppers If grasshoppers become destructive, control them by spraying with an insecticide listed on page 36, Field Peas & Field Beans, or with [2]Guthion 2.4SC at 1.4 L/ha.

Alfalfa Blotch Leafminer This pest of alfalfa is now present throughout most of Ontario but is more damaging in eastern Ontario. The adult leafminer is a small fly which emerges in late May. It is best identified by the numerous pinhole punctures it makes in alfalfa leaflets when it feeds and lays eggs. After the eggs hatch, the developing maggots feed inside the leaflet eating away the center part and producing mines or tunnels that terminate in blotches.

Damage to alfalfa leaves can be extensive and can result in nutritional loss and/or leaf drop. Three generations of the fly about 30 days apart are expected. Cutting generally controls the first generation except on new seedings where an insecticide may be needed. Subsequent generations usually do not correspond to cutting dates. Insecticides effectively control this insect if applied in the "pinhole" stages in late May, early July and mid-August.

Alfalfa Blotch Leafminer Control

Insecticide	Formulation*	Product per ha	Minimum Days to Cutting or Grazing
Cygon	4.8 E or 480 E	550 mL	2
[2]Furadan	4.8 F	280 mL	7
Imidan	50 WP	2.2 kg	7
methoxychlor	2.4 EC	5.5 L	7
	50% WP	2.8 kg	

[2] *Minimum period before reentry into treated areas is 48 hours.*

* *E or EC (Emulsifiable Concentrate); F (Flowable); WP (Wettable Powder).*

Potato Leafhopper The potato leafhopper causes a substantial loss in alfalfa yield and quality some years, particularly during dry seasons when plants are under stress. Damage to direct seedings may be severe. The first cut of established fields escapes injury but as leafhoppers become more prevalent in late June to mid-August, damage may be severe.

The potato leafhopper is a light green, wedge-shaped insect about 0.3 cm long when fully grown. The immature or nymph stage is yellowish-green and wingless but otherwise resembles the adult. Adult leafhoppers may jump or fly. Nymphs walk sideways or backwards to hide on the underside of the leaves.

This insect feeds by sucking plant juices. The alfalfa is stunted and the leaves turn yellow to bronze in color. A discolored V-shaped or triangular area often develops on the tips of leaflets. While this marking is characteristic of leafhopper presence, the leaf discoloration may also be a disease symptom or nutritional deficiency.

Effective control of the potato leafhopper depends on recognizing the adults and nymphs before symptoms become apparent. Check alfalfa fields frequently beginning in late June. See OMAF Factsheet, *Potato Leafhopper in Alfalfa*, Agdex 121/622. When leafhoppers are found, spray with one of the following:

Leafhopper Control

Insecticide	Formulation*	Product per ha	Days to harvest
methoxychlor	2.4 EC	5.5 L	7
	50% WP	2.2 kg	7
Cygon	480 E or 4.8 E	425 mL	2

** E or EC (Emulsifiable Concentrate); WP (Wettable Powder).*

WEED CONTROL IN FORAGES

For weed control recommendations see OMAF Publication 75, *1982 Guide to Chemical Weed Control*.

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CEREAL CROPS

Grain crops deserve to be treated as first-rate crops whenever they are included in a cropping program. They must compete for their place in that program by producing high yields economically. To produce high yields requires that all parts of the grain production package be considered. No one factor can support high yields without the others. No one factor can be neglected without a corresponding decrease in yields.

Improved varieties express their full potential only when they are used in combination with proper seeding times, seeding depth, and recommended seeding rates as well as adequate fertility applications. Indeed they perform well only when diseases, insects, and weeds are eliminated as production hazards.

Integrating the production practices into a package becomes the problem of the farmer. On his ability to do this rests the final yield and outcome of his grain production program.

VARIETY SELECTION

Variety recommendations are general guides for choosing a variety. Descriptive tables accompanying recommendations show characteristics for each variety which may limit its use. Because no variety is perfect, the recommendations should be coupled with experience and information from the description to choose a variety for your use.

Yield data, presented as tonnes per hectare (t/ha), are included to indicate the relative yield performance of recommended varieties in each of the six testing areas in Ontario. The testing areas are listed below and can be outlined by using the heat unit map on page 3.

Test Area I — Southwest of the 2900 heat unit line.

Test Area II — West of Frontenac, between the 2900 and 2300 heat unit lines.

Test Area III — East of Frontenac, between the 2900 and 2300 heat unit lines.

Test Area IV — The Dundalk plains (Grey, Dufferin and Wellington) within the 2500 heat unit line.

Test Area V — Northern Ontario between the 2300 and 1900 heat unit lines.

Test Area VI — Northern Ontario — North of the 1900 heat unit line.

Variety recommendations for grains to be stored and used as high moisture grains and whole plant silages are the same as those to be used for normal grain storage and use.

SPRING GRAINS

Planting date All spring grains respond with higher yields to early seeding. Plant as early as soil conditions permit. The target date should be April 10 for southwestern Ontario, and April 15 for central and eastern Ontario. Planting delays beyond April 20-25 generally result in a yield reduction of 50 kg/ha for each day delayed. Perth and Bruce barley and Elgin and Oxford oats do not show as great a yield reduction with late planting as do other spring cereal varieties. These varieties should be considered for circumstances where late planting cannot be avoided.

Planting rate Spring cereal seeding rate recommendations can be found in the seeding rates table on page . The highest seeding rates should be used where growing conditions are unfavorable or in late planting situations.

Malting Barley purchased in Ontario is grown under contract only. The main malting varieties contracted are Bonanza and Conquest. For further information see OMAF Factsheet, *Malting Barley*, Agdex 114/32.

MIXED GRAINS

Mixed grains occupy a large hectarage in the province. No specific recommendations regarding the best mixtures can be made. Generally the highest yielding varieties of oats and barley in pure stands also perform best in mixtures.

Height and maturity ratings of the components of a mixture must be matched. For example, Oxford oats mix well with Massey barley, and Elgin oats mix well with Perth barley.

SPRING WHEAT

Generally spring wheat in Ontario is much lower yielding than winter wheat, oats and barley. For those farmers, however, who choose to grow spring wheat for feed, the variety **Glenlea** is available.

Glenlea — awnless, white chaff large red grain. Utility grain wheat not equal in milling quality to hard red spring types.

Barley Variety Yields* — Tonne/Hectare**

	Test Areas					
Variety	I (15)***	II (26)	III (8)	IV (8)	V (5)	VI (3)
Herta	4.0	3.4	4.2	3.2	3.4	4.2
Bonanza	4.0	3.4	4.1	3.4	3.8	4.2
Bruce	4.1	3.7	4.5	3.3	3.5	4.6
Laurier	4.3	3.5	4.1	3.3	3.8	4.6
Massey	4.4	3.8	4.5	3.4	3.8	4.5
Mingo	4.3	3.8	4.4	3.6	3.8	4.1
Peguis	3.9	3.5	4.3	3.1	3.8	4.4
Perth	3.8	3.7	4.0	3.4	3.3	3.8
Vanier	4.3	3.8	4.3	3.3	3.7	4.6

** Three-year average (1979-1981)* *** 1 t/ha = 893 lb/ac* ****Number of tests*

Recommended Barley Varieties

Variety	Area Recommended	Type and Maturity	Height	Lodging Resistance	Reaction to Disease* Loose Smut	Spot Blotch	Mildew
2-Rowed							
Herta	All areas	Rough-awned late	Medium to short	Medium	MR	S	R
6-Rowed							
Bonanza	Areas V and VI	Smooth-awned midseason	Medium	Medium to good	R	S	S
Bruce	All areas	Rough-awned early to mid-season	Medium to short	Medium to good	MS	T	R
Laurier**	All areas where mildew or lodging is not a problem.	Rough-awned midseason	Medium	Medium to poor	R	S	S
Massey	All areas	Smooth-awned midseason	Medium	Medium	R	S	R
Mingo****	All areas	Smooth-awned midseason	Medium	Medium	MS	S	MS
Peguis	Areas III, V and VI	Smooth-awned midseason	Medium	Medium	R	S	R
Perth	All areas	Smooth-awned midseason	Medium	Very good	R	T	R
Vanier***	All areas	Smooth-awned midseason	Medium	Medium to poor	MS	S	R

* *See also Disease and Insect Recommendations, pages 29 to 32. R. (Resistant); MR (Moderately resistant); MS (Moderately susceptible); S (Susceptible); T (Tolerant). R indicates resistance to prevalent races only and may not indicate resistance to new races of the disease organism; because of this all varieties should be seed treated with Vitaflo 280 to control loose smut. T indicates that plants become infected but do not suffer significant yield loss.*

** *Laurier may be removed from the recommended list in 1983 because of susceptibility to mildew and lodging.*

*** *Seed supplies of Vanier are limited. It may be removed from the recommended list in 1983.*

**** *2,4-D should not be used on Mingo barley.*

Recommended Oat Varieties

Variety	Area Recommended	Seed Size	Height	Lodging Resistance	Maturity	Reaction to Disease* Septoria	Leaf Rust
Elgin	All areas	Large	Short	Good	2 to 4 days earlier than Garry	MS	MS
Oxford	All areas	Medium (yellow)	Medium	Very good	Midseason to late	T	MR
Sentinel	All areas	Large	Medium	Good	Midseason to late	T	MS

* *See also Disease and Insect Recommendations, page 48 to 53. MR (Moderately Resistant); MS (Moderately Susceptible); T (Tolerant).*

Oat Variety Yields* — Tonne/Hectare**

Variety	Test Areas I (23)***	II (50)	III (12)	IV (12)	V (9)	VI (6)
Elgin	3.8	3.2	3.6	3.1	3.5	3.3
Oxford	4.0	3.3	3.8	3.3	3.9	3.4
Sentinel	3.9	3.2	3.5	3.2	3.6	3.6

* *Six-year average (1976-1981)* ** *1 t/ha = 893 lb/ac* *** *Number of tests*

WINTER GRAINS

For good winter survival, seed early enough to obtain adequate top growth and root development in the autumn. This is particularly important for winter barley. Winter barley matures much earlier than winter wheat and if harvested as a silage crop is suitable for double cropping. Winter cereal seeding rate recommendations can be found in the seeding rates table on page 55.

WINTER TRITICALE

The only winter triticale variety licensed for sale in Ontario is *OAC Wintri*. It has better winter survival compared to the recommended winter wheat varieties. It is resistant to mildew and rust and incidence of ergot infection is very low. *OAC Wintri* is very tall, later maturing than Fredrick, and has poor lodging resistance, especially on heavier soils. High levels of nitrogen fertilization can result in lodging problems with yield losses. The test weight is 10% to 20% below wheat. *OAC Wintri* is a feed grain which is adapted to areas of Ontario where winter injury makes winter wheat production risky. Seed supply will be adequate in 1982.

Recommended Winter Wheat Varieties

Variety	Area Recommended	Test Weight†	Lodging Resistance	Height ‡ (cm)	Winter Survival	Reaction to Disease‡	
						Mildew	Leaf Rust
Fredrick	I, II*, III*	High	Medium to good	110 — 120	Medium	MS	MS
Gordon	II** and III**	Medium to low	Poor	100 — 110	Medium	MS	S
Yorkstar***	II**	Medium to low	Medium to poor	105 — 115	Medium	MS	S
Favor	II**	Medium to low	Medium to poor	105 — 115	Medium	MS	S

† *High = over 76 kg/hL; Medium = 72-76 kg/hL; Low = less than 72 kg/hL in a number of tests.*

‡ *The figures indicate the range generally found in the province.*

‡ *See Disease and Insect Control Recommendations, page 48 to 53. MS (Moderately susceptible); S (Susceptible). All varieties should be seed treated with Vitaflo 250 to control loose smut. For further information see OMAF Factsheet, Winter Wheat in Ontario, Agdex 112/10.*

* *Only where test weight and lodging are problems with other varieties.*

***Not on light droughty soils and other locations where low test weight is a problem.*

*** *Yorkstar may be removed from the recommended list in 1983 because of inferior yield.*

Recommended Winter Barley Varieties*

Variety	Recommended	Type and Maturity	Height	Lodging Resistance	Reaction to Disease**				
					Loose Smut	Mildew	Scald	Net Blotch	Leaf Rust
Huron	Areas south of the 2700 heat unit line, where winter barley can be expected to survive.	6-Rowed Rough-awned Very early	Short	Very good	MS	R	MS	MS	R
OAC Halton		6-Rowed Rough-awned Early	Short	Good	MS	R	MR	MR	R

* *Seed supplies of winter barley are limited for 1982.*

** *See Disease and Insect Control Recommendations, pages 48 to 53. R. (Resistant); MR (Moderately resistant); MS (Moderately susceptible). Both varieties should be seed treated with Vitaflo 280 to control loose smut.*

Winter Wheat Variety Yields* — Tonne/Hectare**

Variety	Test Areas I (18)***	II (24)	III (4)
Fredrick	5.2	4.5	4.7
Gordon	5.0	4.8	5.4
Yorkstar	4.8	4.6	5.0
Favor	4.8	4.7	4.0

* Four-year average (1978-1981)
** 1 t/ha = 893 lb/ac
*** Number of tests

Winter Barley Variety Yields* — Tonne/Hectare**

Variety	Test Areas I (10)***	II (6)
Huron	4.8	3.3
OAC Halton	5.4	4.2

** Five-year average (1977-1981)*
*** 1 t/ha = 893 lb/ac*
**** Number of tests*

Distributors for Cereal Grain Varieties

	Variety	Distributor*
Barley	Bonanza	public
	Bruce	SeCan
	Herta	public
	Laurier	Stewart Seeds
	Massey	SeCan
	Mingo	Stewart Seeds
	Peguis	public
	Perth	King Grain Limited
	Vanier	public
Oats	Elgin	public
	Oxford	Stewart Seeds
	Sentinel	SeCan
Winter Triticale	OAC Wintri	King Grain Limited
Winter Wheat	Fredrick	public
	Gordon	SeCan
	Yorkstar	public
	Favor	Stewart Seeds
Winter Barley	Huron	public
	OAC Halton	SeCan

** Distributor addresses are listed on page 58.*

FERTILIZERS FOR CEREAL CROPS

Fertilizer requirements for cereals in Ontario can best be estimated by using a soil test along with information on the species grown and past management such as manure. Fertilizer recommendations are based on the results of trials run on research stations and farm fields in Ontario. The recommendations in this publication can be expected to produce highest economic returns from the crop when good or above average management is used.

To provide dependable fertilizer recommendations each field should be tested at least once every third year. When large amounts of nutrients are removed from sandy soils (with crops such as hay, corn, silage, potatoes or tomatoes) and manure is not applied, annual testing is advisable as potash soil tests can change rapidly under these conditions.

Where a soil test is not available, a rough estimate of requirements can be obtained from the tables on pages 28 and 29 using the following guidelines:

(a) Where the field has been fertilized regularly for a number of years or heavily in recent years, use one of the rates of phosphate and potash recommended for a MEDIUM soil test rating (see accompanying table).

(b) If the field has received little fertilizer in the past, use one of the rates recommended for a LOW soil test rating (see accompanying table).

Some clay and clay loam soils are naturally high in potassium and do not require any potash fertilizer. Only a soil test can adequately determine potash requirements.

Nitrogen Requirements — Cereal Crops

Crops	N required* kg/ha
Oats, mixed grain, buckwheat, millet, spring rye (southern Ontario)	35
Oats, mixed grain, buckwheat, millet, spring rye (northern Ontario)**	55
Barley, spring wheat, flax, fodder rape, kale, sunflower (southern Ontario)	45
Barley, spring wheat, flax, fodder rape, kale, sunflower (northern Ontario)**	70
Cereals seeded as a nurse crop for forages	15
Mustard	50
Winter wheat, winter barley, winter rye	90***
Canola	100

100 kg/ha = 90 lb/ac
** Where manure is applied or the preceding crop is a legume sod, reduce the nitrogen rates as shown in the tables pages 42 and 43.*
*** Northern Ontario refers to Algoma, Cochrane, Kenora, Manitoulin, Nipissing, Rainy River, Sudbury, Temiskaming and Thunder Bay districts.*
**** 0 to 10 kg nitrogen per hectare at seeding, 90 to 80 kg nitrogen per hectare in April.*

Nitrogen

No soil test is available which is satisfactory for nitrogen under Ontario conditions. Nitrogen fertilizer recommendations for cereal crops are, therefore, based on the crop and on the region of the province and adjusted downward if manure is applied or it the previous crop contains perennial legumes such as alfalfa (see table on page 42). High rates of nitrogen from manures or manufactured fertilizers can cause lodging of cereals.

Phosphate and Potash

Phosphate and potash requirements for cereals are presented in the tables on pages 28 and 29. These recommendations are based on soil tests conducted in the Ontario Ministry of Agriculture and Food soil testing laboratory at the Department of Land Resource Science, University of Guelph. These tables should not be used with soil test readings from other soil testing laboratories unless the methods used are identical to those used in the OMAF laboratory.

Manganese

Manganese deficiency frequently occurs when wheat, oats and barley are grown on an organic soil. It can occasionally occur on mineral soils high in organic matter and on very sandy soils low in organic matter. On oats, manganese deficiency appears as irregular oval gray spots on the leaves. On barley and wheat, it appears more commonly as a light yellow color on the leaves with the veins in the leaf remaining slightly darker green. Manganese deficiency can be confirmed by plant analysis. Correct the deficiency as soon as detected by spraying the foliage with 2 kg/ha of manganese from manganese sulfate (8 kg/ha of manganese sulfate) or 0.2 kg/ha of manganese in chelated form 1-1/2 kg/ha of chelated manganese) in 200 L of water.

Use a "spreader sticker" in the spray. If the deficiency is severe a second spray may be beneficial.

Mixtures of herbicides and foliar fertilizers should not be applied to crops in a single application unless recommended by competent authorities.

For further details on manganese deficiencies and on methods of application, refer to OMAF Factsheet, *Manganese in Soybeans and Small Grain Production*, Agdex 100/531.

Methods of Application

Where phosphate fertilizer is required for cereal crops it is best drilled with the seed and may be accompanied by some or all of the required nitrogen and potash, depending on rates of application.

For spring seeded cereals on sands and sandy loam soils, rates of fertilizer applied with the seed should not exceed 35 kg of nitrogen or 55 kg (nitrogen + potash) per hectare. On loam, silt loam and clay loam soils, rates with the seed should not exceed 45 kg nitrogen or 65 kg (nitrogen + potash) per hectare. No more than 10 kg urea nitrogen per hectare should be applied with the seed. If urea supplies part of the nitrogen in a fertilizer applied with the seed no more than 20 kg total nitrogen per hectare should be applied. For fall seeded cereals rates of fertilizer with the seed should not exceed 15 kg nitrogen or 35 kg (nitrogen + potash) per hectare. The application of fertilizers containing diammonium phosphate (18-46-0) or urea in a seed drill with fall seeded cereals is not recommended because it can cause root damage and reduce yields.

Phosphate Requirements for Cereals Based on OMAF Soil Tests

Phosphorus	Spring barley and mixed grain		Oats, spring wheat and rye, fodder rape, canola, kale, flax, buckwheat		Winter wheat, W. rye, W. barley, W. triticale		Winter or spring grains seeded down	
Soil Test	Soil Test Rating	P_2O_5* Required kg/ha	Soil Test Rating	P_2O_5* Required kg/ha	Soil Test Rating	P_2O_5* Required kg/ha	Soil Test Rating	P_2O_5* Required kg/ha
0 — 3		110		70		70		130
4 — 5		110		60		60		110
6 — 7	LOW	90	LOW	50	LOW	50	LOW	90
8 — 9		70		30		30		70
10 — 12		50		20		20		50
13 — 15	MEDIUM	20	MEDIUM	20	MEDIUM	20	MEDIUM	30
16 — 20		20		0		20		20
21 — 25		0	HIGH	0		0		20
26 — 30	HIGH	0		0	HIGH	0		0
31 — 40		0		0		0	HIGH	0
41 — 50	VERY HIGH	0	VERY HIGH	0	VERY HIGH	0		0
51 — 60		0		0		0	VERY HIGH	0
60+	EXCESSIVE**	0	EXCESSIVE**	0	EXCESSIVE**	0	EXCESSIVE**	0

100 kg/ha = 90 lb/ac

* *Where manure is applied reduce the fertilizer application according to the amount and quality of manure (see page 42). Example: For spring barley in southern Ontario not manured and not following a legume sod, the nitrogen requirement is 45 kg/ha (see nitrogen table on page 27). If the soil tests are 11 for phosphorus and 48 for potassium the phosphate requirement would be 50 kg/ha and the potash requirement 50 kg/ha. These nutrients could be supplied by drilling 250 kg (50 ÷ 20 = 100) of 5-20-20 per hectare to supply the phosphate and potash and broadcasting 100 kg of 34-0-0 or 75 kg of 45-0-0 per hectare to supply the recommended amount of nitrogen.*

** *Excessive readings may cause reduced yield or affect nutrient balance in crops and increase the risk of water pollution.*

Potash Requirements for Cereals Based on OMAF Soil Tests

Potassium	Spring barley and mixed grain		Oats, spring wheat and rye, fodder rape, canola, kale, flax, buckwheat		Winter wheat, W. rye, W. barley, W. triticale with or without seeding down		Spring cereals seeded down	
Soil Test	Soil Test Rating	K_2O* Required kg/ha	Soil Test Rating	K_2O* Required kg/ha	Soil Test Rating	K_2O* Required kg/ha	Soil Test Rating	K_2O* Required kg/ha
0 — 15		90		70		50		90
16 — 30		80		50		40		80
31 — 45	LOW	70	LOW	40	LOW	30	LOW	70
46 — 60		50		30		20		50
61 — 80		40		20		20		40
81 — 100		30	MEDIUM	20	MEDIUM	20		30
101 — 120	MEDIUM	20	HIGH	0	HIGH	0	MEDIUM	20
121 — 150		20	VERY HIGH	0		0		20
151 — 180	HIGH	0		0		0	HIGH	0
181 — 210		0		0	VERY HIGH	0		0
211 — 250	VERY HIGH	0		0		0	VERY HIGH	0
250+	EXCESSIVE**	0	EXCESSIVE**	0	EXCESSIVE**	0	EXCESSIVE**	0

100 kg/ha = 90 lb/ac

* *Where manure is applied reduce the fertilizer application according to the amount and quality of manure (see page 42).*

** *Excessive ratings may cause reduced yield or quality of crops primarily due to magnesium deficiency. Natural levels above 250 occur occasionally on clay and clay loam soils but are not expected to cause problems because soils naturally high in potassium are usually high in magnesium.*

DISEASE AND INSECT CONTROL IN CEREAL CROPS

SEED TREATMENTS

Following cleaning, all cereal seed should be treated with a seed treatment. Good coverage of the seed is essential. Follow the precautions on page 48 when applying any chemical seed treatment.

The following diseases can be controlled by applying one of the treatments listed in the table on page 30.

DISEASES

See OMAF Factsheets, *Leaf and Head Diseases of Barley*, Agdex 114/632; and *Leaf Diseases of Winter Wheat*, Agdex 273/600.

Loose Smut of Barley and Wheat Sow pedigreed seed of a resistant variety. However, these varieties are resistant ONLY to the prevalent races of smut fungus and may not resist other races. Therefore it is STRONGLY RECOMMENDED that ALL BARLEY AND WHEAT SEED BE TREATED AS FOLLOWS: on BARLEY use VITAFLO 280 or a drillbox formulation containing Vitaflo; on WHEAT use VITAFLO 250, which contains more of the active carbathiin than does Vitaflo 280, and is applied as a liquid. Vitaflo 280, containing thiram, is more effective against seedling blight. See OMAF Publication 524, *Smut Diseases of Grain Crops*.

Dwarf Bunt In wheat fields infested with dwarf bunt, none of the presently registered seed dressings are effective. The bunt fungus remains infective for several years in the soil. Some control can be achieved by growing any other crop, including oats and barley, over a period of years on infested land.

Fusarium Head Blight (Scab), Cercosporella Foot Rot and Take All in wheat are a threat in some seasons. Serious damage will be prevented by including one or more of alfalfa, clovers, soybeans, field beans, swede turnips, or oats, in the rotation. Do not grow wheat after wheat, or barley. Do not grow wheat after corn with severe pink ear rot or "pink" stalk rot. Plow down stubble and straw to cover all wheat and barley crop residues.

Spot Blotch, seedling blight, root rot and **head blight** are often serious and widespread in barley and are caused by the same fungus Bipolaris (Helminthosporium, Cochliobolus). The fungus overwinters in seed, barley debris and soil. All barley seed should be treated with the fungicide Vitaflo to control the fungus inside the seed and that which invades seedlings from the soil. To reduce severity of spot blotch and head blight, avoid growing barley after barley, wheat and grasses. Never grow barley on the same land for more than one year in succession. Early planting helps to avoid serious disease in late July. Disease is less severe on barley grown in mixtures with oats. Perth and Bruce barley show some disease resistance.

Net Blotch and Scald occur mainly in winter barley, and especially in cool, humid seasons. OAC Halton is moderately resistant to both diseases. To help prevent buildup of these diseases, avoid growing barley after barley, plow down stubble and straw as completely as possible, and treat seed with Vitaflo.

Septoria Leaf Blotch in oats can cause severe damage in susceptible varieties. The disease is recognized by the appearance of mottled, light and dark brown, elongate blotches on the leaf blade, extending to the leaf sheath and culm. Advanced stages on the culm turn black in color and the weakened culm breaks over easily resulting in damage due to lodging.

Cereal Seed Treatments			Diseases — Oats — covered smut	— loose smut	Barley — covered smut	— loose smut	— seedling blight	Wheat — common bunt	— dwarf bunt	— loose smut	— seedling blight	Rye — seedling blight
Product	**Active Ingredient**	**Formulation****										
Agrox N-M	maneb	P-DB	+	+	+	-	-	+	-	-	+	+
Agrox flowable	maneb	L	+	+	+	-	-	+	-	-	+	+
Busan 30	TCMTB	EC	+	+	+	-	-	+	-	-	+	+
Co-op N-M	maneb	P-DB	+	+	+	-	-	+	-	-	+	+
Polyram Liquid	metiram	L	+	+	+	-	-	+	-	-	+	+
Polyram	metiram	P-DB	+	+	+	-	-	+	-	-	+	+
*Vitaflo 250	carbathiin	L	+	+	+	+	+[1]	+	-	+	-	-
*Vitaflo 280	carbathiin + thiram	L	+	+	+	+	+	+	-	+[2]	+	+
*Vitaflo	carbathiin + thiram	P-DB	+	+	+	+	+	+	-	+[2]	+	+
Seed Treatments with Insecticides***												
Mergamma N-M	maneb + lindane	P-DB	+	+	+	-	-	+	-	-	+	+
Co-op N-M Dual Purpose	maneb + lindane	P-DB	+	+	+	-	-	+	-	-	+	+
*Vitaflo Dual Purpose	carbathiin + thiram + lindane	S	+	+	+	+	+	+	-	+[2]	+	+
Vitaflo Dual Purpose	carbathiin + thiram + lindane	P-DB	+	+	+	+	+	+	-	+[2]	+	+

* *Read the paragraph on seed treatments, and also the section Loose Smut of Barley and Wheat.*

** *EC (Emulsifiable Concentrate); L (Liquid); P-DB (Powder Drill Box); S (Suspension).*

*** *See seed treatment cautions on page 48.*

+, *Recommended for disease listed;* —, *NOT recommended.*

[1] *Reduces Bipolaris (Helminthosporium) seeding blight but may not control other seedling blights and seed decay.*

[2] *Where loose smut in wheat is a problem, use Vitaflo 250 which contains more active carbathiin than Vitaflo 280.*

Snow Mold on winter wheat. In years when snow mold causes great reductions in stands, reseed as soon as possible with a spring grain. This disease does not affect spring-planted grain.

Powdery Mildew is favored by warm, humid weather. For **barley**, use resistant cultivars in areas where powdery mildew is common. The systemic fungicide ethirimol (Milgo E) is registered for control of powdery mildew in **wheat** ONLY. If powdery mildew appears on winter wheat in early spring, consider spraying with ethirimol. A second spray (by air) may be needed at early heading stage if warm wet weather prevails.

Cereal Rusts can be controlled to reduce grain losses. If you regularly have a rust problem on your grain, it is very likely there are common barberry or European buckthorn shrubs close by. These shrubs are hosts of the rust-producing organisms in part of their annual life cycle.

Common barberry is a host for the stem rust fungi. It is a 2 to 3 m shrub with three-pronged spines on the stems, sawtoothed edges on the leaves, and oblong red berries which hang on the plant through the fall and winter.

European buckthorn is a host for leaf rust of oats. It is a shrub or small tree with dark green leaves and round black berries. The leaves hang on until late in the fall and the berries remain most of the winter.

Rust losses commonly are greatest downwind from the shrubs. At times rust spores are blown in from the United States. Border states, except New York, have eradication programs like that of Ontario.

If rust is a problem on your farm, search out and kill these bushes and advise your County Weed Inspector or the Ministry of Agriculture and Food office so that adjacent areas can be checked. Consult Ontario Ministry of Agriculture and Food Publication 49, *Rid Ontario of Common Barberry and European Buckthorn*.

Ergot occurs from time to time on barley. Exercise caution in feeding barley containing the black ergot bodies to livestock, especially swine. Do not sow barley containing ergot.

Barley yellow dwarf or **oat red leaf** This disease was unusually severe in 1959 and 1976. It is unlikely to be severe unless warm weather and southerly winds occur in April. Direct control by spraying the aphids which carry the virus is unlikely to be useful. Early seeding is an advantage (see OMAF Factsheet, *Cereal Virus Diseases*, Agdex 110/632).

Oat Cyst Nematode Damage by the oat cyst nematode is first noticed about two or three weeks after oat plants emerge, at which time heavily infected plants appear to suddenly stop growing, leaves turn pale in color and begin to die back from the tips downward. These plants fail to tiller resulting in a thin stand of stunted plants which produce little grain. Below ground the root systems are severely stunted and usually discolored, from a pale-yellow in early growth to a yellow-brown in mature plants, as compared to the clear white in healthy plants.

To confirm suspected oat cyst nematode damage, dig up affected plants at early heading stage. Carefully wash soil from the roots by dunking in a pail of water, then examine the roots for presence of young cysts. These appear as tiny, pearl-like objects adhering to the young roots. If still in doubt, send a sample of several plants with adhering soil to the Pest Diagnostic Clinic, Department of Environmental Biology, University of Guelph, Guelph, Ontario, N1G 2W1 for diagnosis.

If oat cyst nematodes have caused damage do not plant spring grains the following year. Use legume or row crops in the rotation. Corn can be used if the nematode population is low but will suffer damage if the soil is heavily infested. The nematode invades corn roots but does not reproduce in them; thus consecutive cropping to corn effectively reduces the population of oat cyst nematodes.

For additional information, see OMAF Factsheet, *Oat-Cyst Nematode*, Agdex 113/632.

INSECTS

Wireworms damage cereal crops in certain areas every year. Injury is usually most severe in the two years following grass sod. As a precautionary measure, treat all grain seed with 50% lindane wettable powder, in combination with a fungicide, according to directions on the label. Drill-box formulations are available. Use a wooden paddle to mix the chemical with the seed. Do not breathe the dust stirred up during mixing, wear rubber gloves and a respirator. Follow the precautions on page 48 when using seed treatments.

Armyworms are brown to dark green caterpillars with five longitudinal stripes on their bodies. They are 4 cm long when fully grown. They appear in damaging numbers at intervals of about 10 years except for localized infestations which may appear at anytime. The caterpillars appear in grain crops during late June to mid-July depending upon geographical location. They can best be detected by examining crops frequently during early evening just before sunset; at this time the caterpillars are moving up on the plants to feed. They hide under clumps of grass and clods of dirt during the day. **Five to six larvae in an area 30 by 30 cm warrant chemical control.**

If foliage is heavily notched and most of the caterpillars are less than 4 cm long, treat immediately. When plants are completely defoliated and most caterpillars are fully grown, treatment is not practical. Each field must be assessed and dealt with separately. Armyworms often move in large numbers from one field to another. When this happens it is advisable to spray the border of the invaded field. There is no benefit in applying a control measure once the armyworm is nearly full grown, the pupae present, feeding is extensive and the crop near "maturity". By this time most of the damage will have been done.

Malathion is less effective below 16°C. Where less than 60 L of spray are used per hectare, Lannate provides better control than the other insecticides.

Armyworm Control

Insecticide	Formulation*	Product/ ha	Days to Harvest
[1]Lannate	Liquid	2.3 L	20
Dylox	80% SP	700 g	21
	420 Liquid	1.6 L	
**Sevin	50% WP	2.2 kg	14
	80 S or	1.4 kg	
	85% WP		
malathion	25% WP	6.7 kg	7
	50 EC	2.8 L	
methoxychlor	50% WP	4.5 kg	7
	2.4 EC	8.5 L	

** EC (Emulsifiable Concentrate); S (Sprayable); SP (Soluble Powder); WP (Wettable Powder)*

*** Use the S formation for aerial application.*

[1] Minimum period before reentry is 24 hours.

Bee Poisoning
During the past several years spraying for armyworms, especially with Sevin, has resulted in heavy bee kills. *This must be avoided.* Treat only when needed. Use an insecticide other than Sevin if bees are in the area. Avoid contamination of areas where weeds are in bloom. Do not spray when the wind is blowing. Treat in the late evening. If spraying by aircraft, avoid spraying close to roadsides and adjacent fields where plants are in bloom. Advise local beekeepers of your spraying activities. Your local agricultural representative has a list of beekeepers in your area.

Cereal Leaf Beetle is a metallic blue-green beetle 0.5 cm in length, with reddish-orange head and legs. The larva is slug-like in appearance, 0.6 cm in length when mature and yellowish in color, but its true color is obscured by a black deposit of fecal material. Eggs are pinhead in size, elongate and bright-yellow to dull brown in color located along the mid vein on the upper surface of the leaf.

Both the adults and larvae cause damage by chewing long strips of tissue between the leaf veins. However, most of this injury is done by the larvae in June. Heavily damaged fields take on a silvery appearance.

An effective parasite is now established throughout Ontario.

If the cereal leaf beetle is of concern on your farm, please notify the Ontario Ministry of Agriculture and Food.

Quarantine Regulations A quarantine is in effect to prevent the spread of this insect to other areas of Canada. Growers contemplating the sale of small grains, shelled or ear corn, hay and straw, to buyers west of Wawa or north of a line following Hwy. 101 from Wawa through Matheson to the Quebec border, should inquire at an office of the Plant Protection Division, Agriculture Canada in Windsor, London, Niagara Falls, Toronto, or Ottawa. Write to Agriculture Canada, Ottawa, K1A 0C7, for Publication 1353, *Watch for the Cereal Leaf Beetle.*

Grasshoppers If they become destructive control them as indicated on page 36 (Field Bean Section).

Stored Grain Insects Grain beetles, flour moths, meal worms and mites may infest grain in storage. They can cause considerable damage through contamination, heating and spoilage, shrinkage, loss in food value and lower seed germination. These losses may be prevented by good management.

Measures must be taken before placing newly harvested grain in storage. Thoroughly clean out bins and make sure no grain is left in corners, cracks, behind partitions, between double walls, outside and under bins, or in grain-handling equipment. The sweepings should be burned or buried. If this is not done the new grain can become infested by insects

remaining in the storage from the previous years. For the same reason, never store new grain on top of old. If this is done insects usually move from the old to the new grain because they prefer the higher moisture content of new grain.

Repair storage facilities so they are pest-proof and then spray with a protective insecticide to kill insects that were not removed with the sweepings.

Apply the following two weeks prior to grain storage at the rate of 5 L per 100 m^2. Malathion 50% EC or 500 E at 300 mL per 5 L.

Leave space between feed rooms and storage facilities because feed rooms are difficult to keep free of pests and insects can quickly spread to nearby storage facilities. For the same reason grain should not be stored in buildings that shelter animals or hay because mangers, feed boxes and troughs are often insect-infested. In addition, such buildings are warmer and thus insects can remain active throughout winter.

Grain going into storage should not exceed 14% moisture. Molds, as well as insects, are much more troublesome in moist grain.

Should an insect problem develop in storage, see OMAF Publication 229, *Insects in Farm Stored Grain*, for recommendation on fumigating.

Precautions

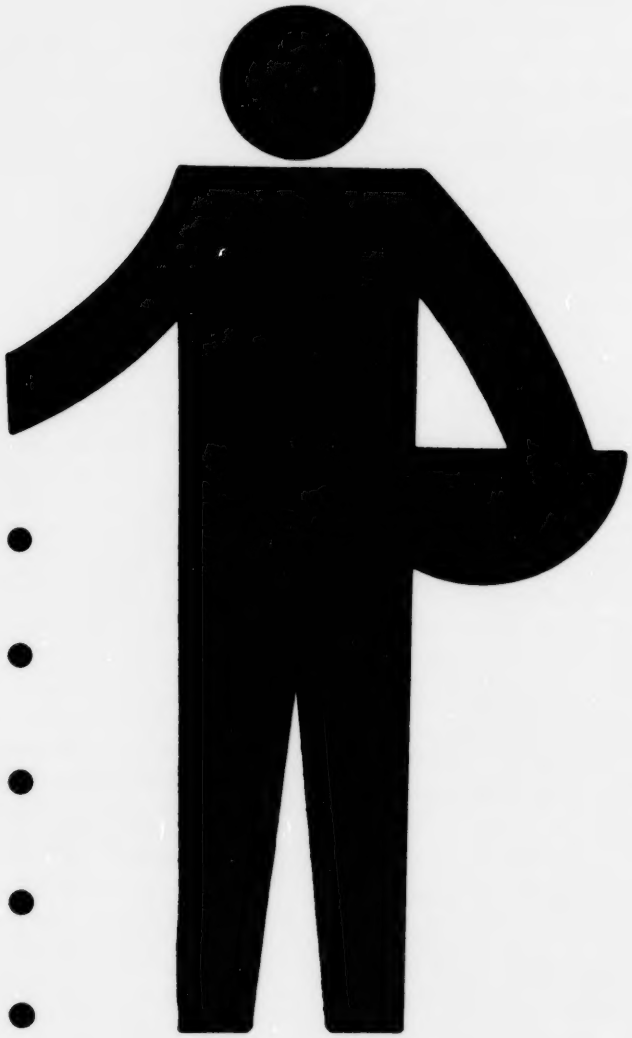
When handling fumigants follow the safety directions given on the manufactured product. Always work in pairs. Wear the recommended gas mask. Remove livestock or poultry that are in the same building, especially if they are under the grain bin.

Some people experience allergic reactions to grain dust and/or molds. Dust masks or respirators will help prevent this when handling grain.

WEED CONTROL IN CEREAL CROPS

Species and varieties vary in their tolerance to herbicides.

For weed control recommendations see OMAF Publication 75: *1982 Guide to Chemical Weed Control.*



FIELD BEANS AND FIELD PEAS

FIELD BEANS

CROP MANAGEMENT

In both white beans and kidney beans, row widths of 60-70 cm are standard due to the nature of the harvesting equipment. For white beans plant 16 to 20 seeds/metre of row (40 to 45 kg/ha). For kidney beans, a seeding rate of 10 seeds per metre (67 kg/ha) is recommended. These seeding rates should result in the highest yield with a minimum of disease problems.

In areas of 2600 to 2900 heat units white beans should be planted between May 20 and June 10. In areas with greater than 2900 heat units, planting should occur between June 5th and 20th.

Kidney beans are normally planted during the first 10 days of June. Planting at this time permits the crop to mature during mid-September when adequate harvest conditions are likely to exist.

FIELD PEAS

VARIETY RECOMMENDATIONS

Century Areas north of 2900-heat-unit line, (see Heat Unit Map on page 3). Seed medium size, smooth and rounded, yellow; used for soup, either whole or split. Flowers are white; matures midseason.

Trapper Areas north of the 2900-heat-unit line, (see Heat Unit Map on page 3). Seed small size, smooth and rounded, yellow; matures five days earlier than Century.

FERTILIZERS FOR FIELD BEANS AND PEAS

Fertilizer requirements for beans and peas in Ontario can best be estimated by using a soil test along with information on past management such as manure. Fertilizer recommendations are based on the results of trials run on research stations and farm fields in Ontario. The recommendations in this publication can be expected to produce the highest economic returns from the crop when good or above average management is used.

To provide dependable fertilizer recommendations each field should be tested at least once every third year. When large amounts of nutrients are removed from sandy soils (e.g. with crops such as hay, corn silage, potatoes, tomatoes), annual testing is advisable as potash soil tests can change rapidly under those conditions.

Where a soil test is not available a rough estimate of fertilizer requirements can be obtained from the accompanying table using the following guidelines:

(a) Where the field has been fertilized regularly for a number of years or heavily in recent years, use one of the

Field Bean Planting Date Recommendations

Variety	2600-2900 Heat Units	2900-3100 Heat Units	3100 or more Heat Units
Seafarer	June 1-10	June 5-15	June 15-25
Kentwood	June 1-7	June 5-12	June 10-22
Sanilac	June 1-5	June 5-10	June 10-20
Ex Rico 23	May 25-31	June 1-7	June 7-14
Fleetwood	May 25-31	June 1-5	June 5-10
Steuben Yellow-Eye	May 25-31	June 1-5	June 5-10

Field Bean Variety Recommendations

Variety	Plant Type	Yield*** kg/ha	Days to Maturity***	Disease Reaction**** Bean Common Mosaic	Disease Reaction**** Delta Anthracnose	1000 Seed Weight g
Seafarer	Bush	2480	86	R	S	190
Kentwood	Bush	2770	92	R	S	230
Sanilac*	Bush	2440	93	MR	S	180
Ex Rico 23*****	Bush	3030	96	R	S	210
Fleetwood	Bush**	2890	99	R	S	190
Steuben Yellow-Eye	Bush	2670	98	S	S	500

* *Sanilac may be dropped from the recommended list in 1983.*

** *Fleetwood is a tall spreading bush.*

*** *Yield and maturity data are averaged over 17 tests in several locations each year from 1979 to 1981.*

**** *R — resistant; MR — moderately resistant; S — susceptible. All varieties except Steuben Yellow-Eye are resistant to alpha, beta, and gamma races of anthracnose, but susceptible to race delta of this disease. Steuben Yellow-Eye has no resistance to Bean Common Mosaic virus or anthracnose.*

***** *Seed supplies will be limited in 1982.*

rates of phosphate and potash recommended for the **medium** soil test rating (see table on page 34);

(b) If the field has received little fertilizer in the past, use one of the rates recommended for **low** soil test rating (see table on page 34). Some clay and clay loam soils are naturally high in potassium and do not require any potash fertilizer. Only a soil test can adequately determine potash requirements.

Nitrogen

Nitrogen fertilizers are not usually required for field beans and peas but where phosphate fertilizers are banded a small amount of nitrogen (10 kg N/ha) may improve the availability of the phosphate. Where field bean yields have been low due to bronzing or root rots, apply an additional 100 kg nitrogen per hectare before planting. Under these conditions nitrogen will increase yield but will not cure the bronzing or the root rot.

Phosphate and Potash

Phosphate and potash requirements for field beans and peas are presented in the table on page 34. These recommendations are based on soil tests conducted in the Ontario Ministry of Agriculture and Food soil testing laboratory at the Department of Land Resource Science, University of Guelph. These tables should not be used with soil test readings from other soil testing laboratories unless the methods used are identical to those used in the OMAF laboratory.

Methods of Application

Fertilizer should not be placed in contact with bean or pea seeds. The fertilizer may be broadcast and plowed down or worked in before planting, or a planter with a separate attachment for fertilizer placement may be used to place the fertilizer 5 cm to the side and 5 cm below the seed.

DISEASE AND INSECT CONTROL IN FIELD BEANS

Seed Treatment

Seed treatments containing diazinon, lindane and a fungicide are required to protect large-seeded crops from seed maggots, wireworms and seed decay organisms. (See page 50 for precautions to follow when using seed treatments.)

Application of the insecticides alone may result in reduced germination. Diazinon is used to control seed maggots; lindane to control wireworms and the fungicide to control disease organisms. The combination seed treatment should be applied every year because maggots are usually an annual pest and the kill of the wireworm seldom is high.

Combinations of diazinon, lindane and captan are available from seed suppliers in individual containers. Directions stated on the container should be followed with care; the mixing in the planter box must be thorough or germination will be reduced and insect control will be poor. For your protection while mixing the chemicals with the seed, use a wooden paddle and wear rubber gloves and a respirator. Do not breathe the dust stirred up during mixing.

DISEASES

Bacterial Blight All bean varieties are susceptible to common bacterial blight but the four commercial white bean varieties are resistant to Halo Blight. The bacteria usually do not overwinter in the field but, to be safe, allow one year between crops. Do not apply manure containing bean refuse to land intended for beans. Almost all infections begin from infected seed. *Do not plant seed which has been harvested from diseased plants.* To avoid spreading this disease, stay out of the fields when foliage is wet.

Anthracnose has resurfaced again as a field bean disease problem. A new race of the fungus (delta race) has spread in Ontario and attacks all recommended white bean varieties. Resistance to the previously known three races has kept

Phosphate and Potash Requirements for Field Beans and Peas Based on OMAF Soil Tests

Phosphorus		Phosphate (P_2O_5)*	Potassium		Potash (K_2O)*
Soil Test	Rating	Required — kg/ha	Soil Test	Rating	Required — kg/ha
0 — 3		80	0 — 15		120
4 — 5		60	16 — 30		110
6 — 7	LOW	50	31 — 45	LOW	90
8 — 9		40	46 — 60		80
10 — 12		30	61 — 80		60
13 — 15	MEDIUM	20	81 — 100	MEDIUM	40
16 — 25	HIGH	0	101 — 120		30
26 — 60	VERY HIGH	0	121 — 150	HIGH	0
60 +	EXCESSIVE**	0	151 — 250	VERY HIGH	0
			250+	EXCESSIVE**	0

100 kg/ha = 90 lb/ac

* *Where manure is applied reduce the fertilizer application according to the amount and quality of manure (see page 42). Example of fertilizer application: If a field bean crop is not manured and the soil tests are 9 for phosphorus and 85 for potassium, the phosphorus requirement is 40 kg/ha and the potash requirement 40 kg/ha (see above table). Ten kilograms of nitrogen are also recommended. These nutrients can be supplied by broadcasting or banding 170 kg/ha of 6-24-24 fertilizer.*

** *For a nutrient which has an excessive rating by soil analysis, the application of this nutrient in fertilizer or manure may cause problems due to reduced crop yield or quality. Phosphorus additions may also increase the risk of water pollution. Potash additions may induce magnesium deficiency on soils low in magnesium.*

white beans virtually anthracnose-free over the years, although other field bean types are known to be susceptible to these races.

The fungus survives from year to year on seed and on infected plant straw, in the soil and on farm machinery. Rainy weather favors this disease as spores are splashed from diseased areas and carried in wind-borne water droplets throughout the field.

Until plant breeding programs provide a measure of control through resistance, the following practices should be followed:

1. Plant anthracnose-free seed.
2. If disease condition of seed is not known, treat with either DCT or IF-PLUS at the recommended rates. These products will not control anthracnose if seed is severely infested.
3. A two-to three-year rotation is essential.
4. Do not cultivate when plants are wet.
5. Clean planting and harvesting equipment thoroughly when moving from one bean field to another.

Root Rot and Bronzing (ozone damage) occur in almost every field every year. The amount of damage is related to the general health of the crop as well as to the amount of root rotting organisms in the soil or ozone in the air. Beans which are not growing well have more injury from root rot and bronzing than vigorous beans.

Eliminating these diseases is impossible. Yield losses caused by them can be reduced by following good soil management practices.

1. Increase nitrogen levels; see under fertilizers.
2. Keep organic matter as high as possible.
3. Maintain or build up good soil tilth by not overworking the soil or working it when it is too wet.

White Mold (Sclerotinia) usually begins to appear by mid-August. The fungus disease develops from windblown spores produced from small black bodies (sclerotia) that survive in the soil over winter. The sclerotia are found on and in stems and pods of infected plants and at harvest are scattered over the soil. These sclerotia are not toxic to livestock. Initial infection occurs on plant tissues such as older flowers or possibly lower leaves that have died from other causes. Infection of healthy pods, stems and leaves results from infected plant parts coming in contact with healthy plant tissues. Weather conditions, especially rainfall, play a critical role in disease development. In areas where disease is widespread, crop rotation has not given control. Spraying with fungicides is considered essential in fields with the following conditions:

— a past history of white mold;
— above average foliage growth;
— exposure to continuous wetness and air temperatures between 15 and 20°C (day and night temperatures) for more than 48 hours (fewer hours if temperatures are higher).

For most effective control, foliar sprays must be applied at first bloom prior to appearance of disease. Sprays applied after disease first appears do not control white mold effectively.

White Mold Control

Fungicide	Formulation*	Product per ha	Days to Harvest
Benlate	50% WP	1.7-2.2 kg	14
Easout	70% WP	1.7-2.2 kg	1
Botran	75 W	3.3 kg	2
Bravo**	500 F	4.8 L	**

Do not feed bean refuse to livestock.
** F (flowable); W or WP (wettable powder).*
*** Do not apply after full bloom.*

INSECTS

Green Cloverworm is a greenish caterpillar that feeds on bean foliage, causing holes in leaves and reducing yield. Shake worms from plants onto paper to count them. **If more than five caterpillars are found per 30 cm of row, apply an insecticide as listed below:**

Cloverworm Control

Insecticide	Formulation*	Product per ha	Days to Harvest
Endosulfan or Thiodan	400 EC 4 EC	1.4 L	2
[2]Guthion	50% WP	1.1 kg	3
	2.4 SC	2.2 L	3
	or		
	22% SC		
Sevin	80 S, or 85% WP	1.4 kg	3

[2] Minimum period before reentry into treated areas is 48 hours.
** EC (Emulsifiable Concentrate); S (Sprayable); SC (Sprayable Concentrate); WP (Wettable Powder).*

Mexican Bean Beetles and Potato Leafhoppers cause damage some years. Growers should check the descriptions below and treat their plants when insects are causing damage.

Mexican bean beetles are oval in shape with 16 small black spots on their otherwise yellowish back. The larvae are easily identified by their yellow color and the presence of six rows of long branching, black-tipped spines.

Potato leafhoppers are pale green, wedged-shaped insects about 0.3 cm long. They are best identified by observing how they walk. They can walk equally well forwards, backwards and sideways when disturbed.

Leafhoppers are more likely to cause reductions in yield when they are numerous early in the season and the crop is under stress from drought. When control is necessary, apply one of the insecticides in the table. A second application may be necessary; recheck the fields.

Mexican Bean Beetle and Leafhopper Controls

Insecticide	Formulation*	Product per ha	Days to Harvest	Comments
Cygon	4.8 E or 480 E	0.7-1.0 L	7	Do not use straw for feed or bedding.
Endosulfan or Thiodan	400 EC 4 EC	1.4 L	2	
[2]Guthion	2.4 SC or 22% SC	2.25 L	3	
malathion	25% WP	4.5 kg	1	
Sevin	50% WP	1.1-2.2 kg	3	Use lower rate for bean beetles.
	80 S or		3	
	85% WP	0.8-1.3 kg	3	

[2]*Minimum period before reentry into treated areas is 48 hours.*

* *E or EC (Emulsifiable Concentrate); S (Sprayable); SC (Sprayable Concentrate); WP (Wettable Powder).*

Grasshoppers Maintain weed-free headlands and fencerows. If grasshoppers become a problem, spray outer rows of the field.

Grasshopper Control

Insecticide	Formulation*	Product per ha	Days to Harvest	Comments
Cygon	4.8 E	0.8 L	7	Do not use straw for feed or bedding.
diazinon	50% WP	1.1 kg	7	
malathion	25% WP	3.4 kg	7	
	50% EC	1.7 L	7	
Sevin	50% WP	3.4 kg	3	
	80 S, or		3	
	85% WP	2.0 kg	3	

* *E or EC (Emulsifiable Concentrate); S (Sprayable); WP (Wettable Powder).*

WEED CONTROL IN FIELD BEANS AND PEAS

For weed control recommendations see OMAF Publication 75, *1982 Guide to Chemical Weed Control.*

SOYBEANS

CROP MANAGEMENT

Soybeans should be planted from May 15 to May 30. Later planting will cause marked yield decreases. Choose a variety that will mature every year in your locality. See heat unit map on page 3.

When you intend to sow fall wheat following a soybean crop, consider a soybean variety earlier than a full-season variety for your area.

When seeding, make allowance for variety seed-size differences. A seeding rate of 67 kg/ha (1 bu/ac) is adequate for all varieties in 36 to 71 cm rows. Eighteen centimetre rows are recommended under short growing season conditions. Adjust seeding rate upward for lower germination or for soils which crust badly. Uniform depth of seeding 3 to 5 cm is important.

Inoculation

When soybeans are grown on land for the first time, inoculation with soybean rhizobia is essential for high yields. Under these conditions, soil-applied granular inoculants produce more consistent nodulation and higher yields than seed-applied powders. Therefore, granular inoculant is recommended on new soybean land, at rates from 5 kg/ha in wide rows up to 10 kg/ha in rows 18 cm apart.

Planting Recommendations

Row width centimetres*	kg/ha	Seed drop per metre of row** 5500 seeds/kg	6600 seeds/kg
71	67	27	33
53	67	21	26
36	67	14	16
18	90	10	10

Granular inoculant is applied through granular insecticide applicators on a corn planter, with delivery tubes brought forward to place the inoculant in the seed furrow. In a grain drill, the grass seed box can be used for granular inoculant with tubing added to drop the inoculant with the seed. With newer drills, the granular inoculant may be applied through the fertilizer hopper.

After nodulated soybeans have been grown on a field, the use of granular inoculant is not recommended because it usually does not cause yield increases. If soybeans have only been grown for one or two years, or if they have not been grown for several years, soybean seed should be inoculated with powdered peat inoculant to ensure nodulation. In fields which have grown soybeans many times, inoculation is not necessary.

Soybean Variety Recommendations and Description

Variety	Heat Units Required	Hilum Color	Seeds per kilogram	Phytophthora Root Rot Reaction % Plant Loss*	Distributor**
Maple Presto	2200	light-brown	6030	18	public variety
Maple Amber***	2450	brown	5560	21	public variety
McCall	2550	yellow	6030	28	public variety
Maple Arrow	2550	brown	5030	25	public variety
Evans	2700	yellow	6040	24	public variety
Gesto	2800	yellow	6880	23	Stewart Seeds
0877	2800	light-gray	5750	32	Pioneer Hi-Bred Ltd.
Hodgson	2900	buff	5810	18	public variety
A1564	2900	yellow	5650	11	Maple Leaf Mills
Prestige	2900	brown	5920	32	King Grain Ltd.
S1346	2900	yellow	5100	16	National N.K. Seeds Ltd.
Hawk	2950	black	5590	10	W.G. Thompson & Sons Ltd.
1677	3000	yellow	6670	25	Pioneer Hi-Bred Ltd.
Wells	3000	black-brown	5900	41	public variety
Coles	3050	yellow	5170	14	public variety
Olinda	3050	buff	6140	16	Stewart Seeds
A2575	3050	buff	5780	18	Maple Leaf Mills
Falcon	3050	yellow	5780	41	W.G. Thompson & Sons Ltd.
Corsoy 79[1]	3100	yellow	6020	8	public variety
Dawn	3100	yellow	5990	26	U.C.O.
Kentland	3100	buff	5850	8	National N.K. Seeds Ltd.
S2596	3100	brown	5020	16	National N.K. Seeds Ltd.
Premier	3100	yellow	5650	7	King Grain Ltd.
Starlite	3100	yellow	5850	32	Maple Leaf Mills
Harcor	3150	yellow	6210	20	public variety
Amsoy 71	3200	yellow	5210	38	public variety

* *Three-year average (1979-81) in a field at Woodslee heavily infested with phytophthora (See soybean diseases page 39).*

** *Distributor addresses are listed on page 58.*

*** *Metribuzin should not be used on Maple Amber.*

[1] *Seed supplies will be limited in 1982.*

Agronomic Data							
Testing Areas	**Variety**	**Heat Unit Rating**	**Yield* (t/ha)**	**Yield** Index %**	**Days from Planting to Maturity**	**Plant Height (cm)**	**Lodging 1 = standing 5 = flat**
3-year average of 7 trials at Ottawa, Elora, and Kemptville	+ Maple Presto	2250	2.7	81	102	69	1.3
	Maple Amber	2450	3.3	99	113	78	1.9
	McCall	2550	3.5	104	117	78	2.0
	Maple Arrow	2560	3.6	107	120	82	2.1
	Evans	2700	3.7	110	129	93	2.4
		Average yield	3.37				
2-year average of 6 trials at Woodstock, Denfield, and Centralia	Maple Arrow	2550	2.8	101	110	77	1.5
	Evans	2700	2.8	101	118	85	1.8
	Gesto	2800	2.6	94	120	86	2.2
	0877	2800	2.9	105	121	85	1.7
	Hodgson	2900	2.7	98	126	90	1.7
		Average yield	2.76				
3-year average of 8 trials at Fingal, Oil City, Inwood, and Ridgetown	Evans	2700	3.0	92	120	84	1.5
	Gesto	2700	3.0	92	120	86	1.8
	Hodgson	2900	3.4	104	124	91	1.7
	A1564	2900	3.3	101	126	95	1.8
	Prestige	2900	3.2	98	126	93	1.9
	S1346	2900	3.4	104	127	77	1.1
	Hawk	2950	3.3	101	128	79	2.5
	1677	3000	3.6	110	129	89	2.0
	Wells	3000	3.2	98	129	92	1.3
	Coles	3050	3.3	101	131	106	2.5
		Average yield	3.27				
3-year average of 8 trials at Fletcher, Woodslee, and Malden	Hodgson	2900	3.6	102	120	89	1.9
	1677	3000	3.5	100	123	88	2.3
	Wells	3000	3.3	94	124	95	1.5
	Coles	3050	3.4	98	125	100	2.8
	Olinda	3050	3.4	96	125	95	2.6
	A2575	3050	3.5	99	126	98	1.7
	Falcon	3050	3.3	94	126	94	1.7
	Corsoy 79	3100	3.6	103	127	100	2.6
	Dawn	3100	3.6	104	127	99	2.8
	Kentland	3100	3.6	103	127	91	2.4
	S2596	3100	3.6	102	127	84	1.6
	Premier	3100	3.6	103	127	92	2.3
	Starlite	3100	3.6	103	127	97	2.6
	Harcor	3150	3.6	102	128	101	3.0
	Amsoy 71	3200	3.4	98	129	104	2.6
		Average yield	3.50				

* *t/ha = 1 tonne per hectare = 15 bu/ac*

** *For each test area Yield Index is expressed as a percentage of the average yield of all recommended varieties grown in that test area.*

\+ *Maple Presto is a very early variety considered to be too early and too low yielding for general use in Ontario. However, this variety may be considered for late planting situations in short season areas.*

FERTILIZERS FOR SOYBEANS

Fertilizer requirements for soybeans in Ontario can best be estimated by using a soil test along with information on past management such as manure. Fertilizer recommendations are based on the results of trials run on research stations and farm fields in Ontario. The recommendations in this publication can be expected to produce the highest economic returns from the crop when good or above average management is used.

To provide dependable fertilizer recommendations, each field should be tested at least once every third year. When large amounts of nutrients are removed from sandy soils (e.g. with crops such as hay, corn silage, potatoes, tomatoes) annual testing is advisable as potash soil tests can change rapidly under those conditions.

Where a soil test is not available a rough estimate of fertilizer requirements can be obtained from the accompanying table using the following guidelines:

Phosphate and Potash Requirements for Soybeans Based on OMAF Soil Tests

Phosphorus		Phosphate (P_2O_5)*	Potassium		Potash (K_2O)*
Soil Test	Rating	Required — kg/ha	Soil Test	Rating	Required — kg/ha
0 — 3		80	0 — 15		120
4 — 5		60	16 — 30		110
6 — 7	LOW	50	31 — 45	LOW	90
8 — 9		40	46 — 60		80
10 — 12		30	61 — 80		60
13 — 15	MEDIUM	20	81 — 100	MEDIUM	40
			101 — 120		30
16 — 25	HIGH	0	121 — 150	HIGH	0
26 — 60	VERY HIGH	0	151 — 250	VERY HIGH	0
60+	EXCESSIVE**	0	250+	EXCESSIVE**	0

100 kg/ha = 90 lb/ac

* *Where manure is applied reduce the fertilizer application according to the amount and quality of manure (see page 42). Example of fertilizer application: If a soybean crop is not manured and the soil tests are 9 for phosphorus and 85 for potassium, the phosphate requirement is 40 kg/ha and the potash requirement 40 kg/ha (see above table). Ten kilograms of nitrogen are also recommended. These nutrients can be supplied by broadcasting or banding 170 kg/ha 6-24-24 fertilizer.*

** *For a nutrient which has an excessive rating by soil analysis, the application of this nutrient in fertilizer or manure may cause problems due to reduced crop yield or quality. Phosphorus additions may also increase the risk of water pollution. Potash additions may induce magnesium deficiency on soils low in magnesium.*

(a) Where the field has been fertilized regularly for a number of years or heavily in recent years, use one of the rates of phosphate and potash recommended for the MEDIUM soil test rating.

(b) If the field has received little fertilizer in the past, use one of the rates recommended for a LOW soil test rating. One exception is clay and clay loam soils. Some clay and clay loam soils are naturally high in potassium and do not require any potassium fertilizer. Only a soil test can adequately determine potash requirements.

Nitrogen

Where soybeans have not been grown recently, the seed should be inoculated with nitrogen fixing bacteria before seeding.

Nitrogen fertilizers are not usually required for soybeans but where phosphate fertilizers are banded a small amount of nitrogen (10 kg N/ha) may improve the availability of the phosphate.

Phosphate and Potash

Phosphate and potash requirements for soybeans are presented in the table on page 39. These recommendations are based on soil tests conducted in the Ontario Ministry of Agriculture and Food soil testing laboratory at the Department of Land Resource Science, University of Guelph. These tables should not be used with soil test readings from other soil testing laboratories unless the methods used are identical to those used in the OMAF laboratory.

Manganese

Manganese deficiency may occur in soybeans. The upper leaves range from pale green (slight deficiency) to almost white (severe deficiency) while the veins remain green. Correct the deficiency as soon as detected by spraying the foliage with 2 kg/ha of manganese from manganese sulfate (8 kg/ha of manganese sulfate) or 0.2 kg/ha of manganese in chelated form (1-1/2 kg/ha of chelated manganese) in 200 L of water. Use a "spreader sticker" in the spray. If the deficiency is severe, a second spray may be beneficial.

Never use spray equipment which has been used for spraying hormone-type herbicides such as 2,4-D. Beans are very sensitive to this type of herbicide.

For further details on manganese deficiency and on methods of application refer to OMAF Factsheet, *Manganese in Soybeans and Small Grain Production*, Agdex 100/531.

Methods of Applications

Fertilizer should not be placed in contact with soybean seeds. The fertilizer may be broadcast and plowed down or worked into the soil either in the fall or spring; or a planter with a separate attachment for fertilizer placement may be used to place the fertilizer 5 cm to the side and 5 cm below the seed.

DISEASE AND INSECT CONTROL IN SOYBEANS

Seed Treatment

Seed treatments are recommended for control of seed maggots, wireworms and seed decay organisms. Lindane and diazinon are the two most commonly used insecticides found in combination seed treatments. When used alone they can cause plant injury by reducing plant stand, growth and yield. The addition of a fungicide not only makes the effect of these products safer, but will provide control of seed and seedling rots.

When desiring full insect and disease protection use products containing diazinon, lindane and captan such as, B-3, DLC, DL-Plus or Drillbox DL plus Captan, Only B-3 contains sufficient captan fungicide to be used on untreated soybean seed. DLC, DL-Plus and Drillbox DL plus Captan contain one half as much Captan and therefore should only be used on seed previously treated with a fungicide.

In areas where insect problems are minimal, use seed treatments containing fungicide only, such as vitaflo, captan or thiram.

DISEASES

Downy Mildew appears as yellow, and later, brown spots on the leaves during August and September. In moist weather a pale blue to gray, downy growth of the mildew fungus appears on spots on the lower leaf surface. Severely affected leaves may drop prematurely. Whitish growth of the fungus may encrust the seeds, even within pods that appear healthy. Varieties differ in susceptibility; the variety Evans is highly susceptible, but Maple Arrow has considerable resistance. Rotate soybeans with other crops and plow under crop refuse.

Powdery Mildew infects soybean leaves under cool, cloudy conditions in late August and early September. The fungus produces a white powdery growth on the upper surface of infected leaves. At present, no control measures are available. The spread of this disease is restricted by dry sunny weather.

White Mold may cause damage to soybeans under cool, wet conditions. Stems, pods and leaves infected with white mold are pale brown and water-soaked in appearance. Frequently a white cotton-like growth and small dark bodies (Sclerotia) can be seen on or within stems of diseased plants. The sclerotia survive many years in soil. In summer, disease arises from airborne spores produced on the Sclerotia. Crop rotation may be useful for disease control in areas where white mold is uncommon. White mold is more likely to occur in soybeans following any bean crop in which white mold was present in previous years. Avoid this crop sequence if possible. In areas where white mold is common, however, the disease may appear in spite of crop rotation because of windblown spores from other fields. Some differences in disease severity in varieties have been noted. Variety 'Evans' appears highly susceptible.

Phytophthora Root Rot is a potential problem where soybeans are grown on clay soils in parts of southwestern Ontario. Diseased plants, 15 to 60 cm tall, wilt and die in June and July. A reddish-brown discoloration extending from the roots to the lower nodes is evident on the stems of wilted plants. Dead plants may occur as either a few in a row or as patches in low areas of fields. A few plants die in late August or September. Control of Phytophthora root rot requires a combination of soybean variety selection and good soil management. Some varieties have a little resistance (see page 37), however, none of the varieties now grown are completely resistant. Any soil management practice which reduces the chance of soil compaction or waterlogging will decrease the incidence of the disease. On clay soils where Phytophthora root rot may be a problem, the following procedures are recommended.

(a) Choose a variety with a low percentage of infected plants (see page 37).

(b) Prepare seedbeds by plowing rather than disking.

(c) Do not plow or disk when the soil is wet.

(d) Plow in crop residues or manure to improve soil structure.

(e) Include crops in a rotation that improves soil tilth.

(f) Inspect soybean fields for dead plants in late July or early August.

Rhizoctonia root rot has been found in most of the soybean growing areas of southwestern Ontario. Symptoms of the disease are very similar to plants infected with Phytophthora except reddish lesions produced on roots and lower stems seldom extend above the soil line. There are no commercial varieties that are tolerant to Rhizoctonia.

INSECTS

Insect damage is seldom enough to cause soybean yield losses in Ontario. Green cloverworms may be prevalent in some years. Control measures for green cloverworms and grasshoppers are listed on pages 35 and 36 of the Field Bean section. *Follow precautions for handling chemicals. See page 48 to 53.*

WEED CONTROL IN SOYBEANS

For weed control recommendations see OMAF Publication 75, *1982 Guide to Chemical Weed Control.*

SOIL MANAGEMENT AND FERTILIZER USE

Ontario currently uses about 1,000,000 tonnes of fertilizers annually. High yields can be produced efficiently only when fertilizer use is related to the fertility level of the soil and to other additions of nutrients in manure, crop residues, etc. At one extreme, on very low fertility soils, it is occasionally profitable to add as much or more nitrogen, phosphorus, or potassium in the fertilizer as a crop removes. At the other extreme, on high fertility soils or following heavy application of manures, fertilizer may not be profitable and occasionally may reduce yields.

SOIL TESTING

Why Soil Test?

Soil testing is currently by far the most accurate tool available to Ontario farmers to determine the amounts of *phosphorus, potassium* and magnesium fertilizers and lime which should be applied to field crops.

Alternatives to the Soil Test

1. Plant analysis is the main tool used for tree fruits and can serve as additional information supporting the soil test for field and vegetable crops.
2. Nutrient deficiency symptoms on crop leaves are helpful in some cases but have serious drawbacks in others, particularly with potassium and phosphorus.
3. It is occasionally suggested that a farmer apply the amounts of nutrients removed by the crop. This has some application for nitrogen as we do, with some crops, apply close to what the plant removes. It has little relevance for other nutrients in Ontario. Many of our clay and clay loam soils have sufficient potassium to last for many years and application of potassium each year on those soils is a waste of money and ignores one of the few advantages which clay soils have over coarser-textured soils.

The soil testing program is the main guide with help from plant analysis and nutrient deficiency symptoms to determine your fertilizer requirements for a specific crop on a specific field.

What does the OMAF Soil Testing Program Provide for the Farmer?

Fertilizer recommendations based on soil test results are made by Agricultural Representatives, Fruit and Vegetable Specialists and Soils and Crops Specialists, in county and district offices of the Ministry of Agriculture and Food.

The soil testing program provides recommendations for nitrogen, phosphate, potash and magnesium fertilizer along with recommendations for the amount and type of lime you should apply. These recommendations are expected to produce maximum profits under recommended management methods. Some fertilizer is recommended at soil test levels slightly above those where crop response is profitable. This is done (a) for maintenance (to maintain high soil nutrient levels), and (b) to allow for some error in sampling the field. For high value crops such as tobacco the maximum profit we aim for will require essentially the same amount of fertilizer as maximum crop value (maximum yield with high quality). For low value crops such as oats there may on occasion be a slight yield response to rates of fertilizer above those recommended for maximum profit. However, trials on farm fields with corn have shown no yield response to rates of fertilizer above those recommended by soil test.

Soil Tests from Other Laboratories

Each year a number of farmers ask OMAF staff to interpret soil test results from other laboratories. Provided the other laboratory uses the identical chemical tests used in the OMAF laboratory and expresses their test results in the same units, the OMAF fertilizer requirements for phosphorus and potash can be applied. However, it is rare that this is the case.

Only soil tests using chemical extractants which have been calibrated by a number of field experiments on Ontario soils can be relied on to provide accurate fertilizer recommendations. Be certain that the service you are using measures up to these standards.

Soil Sampling

Soils may be sampled with a sampling tube or with a shovel. Each field, or uniform section of a field should be sampled separately. At least 20 soil cores 15 cm deep should be taken from any field or area sampled up to 5 ha in size. For fields larger than 5 ha, proportionately more cores should be taken. The more cores taken the more likely the soil sample is to provide a reliable measure of the fertility in the field. The soil can be collected in a clean pail, the lumps should be broken, the soil mixed well and a soil sample box full forwarded for testing. The area sampled should be traversed in a zigzag pattern to provide a uniform distribution of sampling sites. Parts of a field that differ in appearance of soil or crop, in previous fertilization, manuring or liming should be sampled separately if they are large enough to fertilize separately. It can be quite informative to sample problem areas separately, occasionally, even if they are too small to fertilize separately. Avoid sampling recent fertilizer bands, dead furrows, areas adjacent to gravel roads or where lime, manure, compost or crop residues have been piled.

When to Sample

Each field should be sampled once every two to three years. Potash levels can change quickly where large amounts of nutrients are removed from sandy soils (for example with crops such as alfalfa hay, corn silage, potatoes or tomatoes) and manure is not returned. Under these conditions samples should be taken each year.

The results of soil tests are forwarded to the county and district offices of the Ontario Ministry of Agriculture and Food within two weeks of receipt of samples in the laboratory. However, to allow time for mailing and analysis, soil samples from fields to be fertilized for spring seeding crops should be taken the previous fall. Because of the rush of harvest and the frequency of poor weather late in the fall, summer may be a more convenient time to sample for some farmers. Soil samples from fields to be fertilized for fall wheat, or from hay and pasture fields to be fertilized in late summer, should be taken in the spring or early summer.

Sample Boxes and Information Sheets

Soil sample boxes and information sheets may be obtained from any district or county office of the Ministry of Agriculture and Food or from the Soil and Plant Analysis Laboratory, Department of Land Resource Science, University of Guelph, Guelph, Ontario N1G 2W1.

Analyses Available through the Soil Testing and Plant Analysis Laboratory, Department of Land Resource Science, University of Guelph

Material	Analyses	Availability	Cost/Sample
1. Farm soils	Plant available phosphorus, potassium and magnesium + pH (calcium and salt concentration* if required)	all times	no charge — cost borne by Ontario Ministry of Agriculture and Food
2. Home garden and lawn soils	As above	all times	$1.00
3. Soil	Available manganese and zinc	all times	$3.00
4. Soil	Organic matter	all times	$5.00
5. Soil	Texture (% sand, silt and clay)	enquire at lab	quoted on request
6. Soil	Other analyses may be available for groups of over 20 samples	enquire at lab	quoted on request
7. Liming materials	Calcium and magnesium content, neutralizing value, particle size analysis	all times	$15.00
8. Dried plant and other organic materials**	Nitrogen, phosphorus, potassium, calcium, and magnesium	all times	$11.00
9. Dried plant and other organic materials**	Boron, copper, manganese and zinc	all times	$11.00
10. Dried plant and other organic materials**	9 elements listed in 8 and 9	all times	$14.00
11. Manure and other moist organic matter	Nitrogen, phosphorus, potassium, calcium, and magnesium and % DM	all times	$13.00
12. Manure and other moist organic matter	Boron, copper, manganese and zinc	all times	$13.00
13. Manure and other moist organic matter	9 elements listed in 11 and 12	all times	$16.00
14. Dried plant, manure, and other organic materials	Sulfur, selenium, arsenic, sodium, iron, cadmium, chromium, lead, nickel, mercury and some other metals	enquire at lab	quoted on request

* *Electrical conductivity.*

** *Analysis of feed samples is arranged through the Department of Animal & Poultry Science.*

Management practices which affect a soil test recommendation are: manure application, legume sod plowed down, and the crop to be fertilized. This information is essential for a reliable fertilizer recommendation, and should be recorded on the field information sheet which must accompany the soil sample sent in for analysis.

Changes in Crop or Management

Fertilizer requirements on the OMAF soil test report are for specific crops and management. If the crop management is changed in regard to legumes plowed down or manure applied, the adjustments in fertilizer requirements may be made using the manure and legume sod adjustments in the tables on pages 42 and 43. If the crop is changed from that for which the recommendation was made, a new recommendation can be obtained by looking up the appropriate table under the specific crop section in this publication.

NITROGEN ADJUSTMENT FOR LEGUMES PLOWED DOWN

When sod containing perennial legumes such as alfalfa, trefoil and clover are plowed under, they supply an appreciable amount of nitrogen to the following crop. The accompanying table shows reductions which should be made in nitrogen fertilizer applications to crops following sod containing legumes.

Adjustment of Nitrogen Requirement Where Sod Containing Legumes is Plowed Down

Type of Sod	For all Crop Deduct from N Requirement kg N/ha
Less than 1/3 legume	0
1/3 to 1/2 legume	55
1/2 or more legume	110
Perennial legumes seeded and plowed in the same year.	20*

* *Applies where the legume stand is thick and over 15 cm high.*

MANURE

Manure can supply organic matter and an appreciable part of the nutrients required for production of crops.

Manure Storage

For maximum conservation of plant nutrients manure should be stored in a way that saves the liquid portion and allows as little exposure to the air as practicable.

Where to Use Manure

Manure is used most effectively when applied for crops that require nitrogen and on soils that require phosphorus and potassium. Manure should not be supplied at rates supplying more nitrogen than the crop requires. Corn and grass hay or pastures have higher nitrogen requirements than many other crops and therefore respond more to nitrogen in manure. Legumes such as alfalfa, trefoil and soybeans do not make efficient use of the nitrogen in manure.

Manure on Perennial Legumes

Do not apply manure to perennial legumes such as alfalfa and trefoil when there is snow cover because ice frequently forms under the manure and can kill the plants. If manure must be applied to perennial legumes it should be applied to the thinnest or oldest stands, preferably after the first cutting.

Applications to Cereals

Manure or nitrogen fertilizers applied to cereals at rates supplying more nitrogen than the crop requires can cause lodging and should be avoided.

Manure on Grass Sod

Manure is an effective source of nutrients for grass sod. However, where manure is to be applied in late spring or summer some nitrogen fertilizer should be applied early in the spring.

Manure on Leaves

Avoid application of liquid manure to crop foliage as it can damage the crop. On perennial forages application to the foliage cannot be avoided but applications early in the spring or immediately after haying are preferred.

Short-Term Value of Manure

The following table shows the reductions in fertilizer application which are recommended for a particular crop where manure is applied in the year that the crop is grown. These values assume, for manure applied in the spring and not immediately covered with soil, that 50% of the nitrogen (75% for poultry manure), 40% of the phosphate and 90% of the potash are as available in the year of application as the nutrients in manufactured fertilizer.

Long-Term Value of Manure

The long-term availability of phosphorus, potassium and magnesium in manure is best measured by soil tests. Some of the nitrogen in cattle and swine manure also continues to become available for plant growth and affects the nitrogen fertilizer requirements in the years after application. Adjustments for residual nitrogen in manure are presented in the accompanying table.

These adjustments apply while manure continues to be used and for the first year after manure application ceases. In addition to adjustments for the residual long-term value, the normal short-term adjustment in nitrogen requirement should also be made for manure applied in the year the crop is grown, as indicated in the accompanying table.

No adjustment should be made for the long-term effects of poultry manure because most of the available nitrogen it contains is released in the year of application.

Adjustment of Nitrogen Requirement for Value of Cattle or Swine Manure Applied in Previous Years

Rate of Manure Application		Consecutive Years of Manure Application	Reduction in Crop Nitrogen Requirement kg N/ha
Solid t/ha*	Liquid Cubic m³/ha*		
20	50	5	20
20	50	10	30
40	100	3	20
40	100	5	30
40	100	10	30

** 66 bu manure = 1 metric tonne approximately. 10 tonne/ha = 4.5 ton/ac. One metre³ = 220 imperial gallons. One metre³ /ha = 90 gal/ac.*

Reductions in Fertilizer Application Where Manure is Applied in the same Crop Year

Solid Manure		Liquid Manure		Nitrogen (kg/ha)			Phosphate	Potash
Tonnes per Hectare*	Tons per Acre*	Cubic Metres Per Hectare**	Gallons Per Acre**	F &W	Spr	Spr C***	P_2O_5 (kg/ha)	K_2O (kg/ha)
				Subtract from Fertilizer Requirement				
			Cattle or Mixed Livestock Manure					
20	9	50	4400	25	50	60	20	90
30	13	75	6700	40	75	90	30	135
40	18	100	8900	50	100	125	40	180
			Swine Manure					
20	9	30	2700	25	50	60	25	35
30	13	45	4000	40	75	90	35	50
40	18	60	5300	50	100	125	50	70
			Poultry Manure					
4	2	10	900	20	45	60	25	20
10	4	25	2200	50	110	140	60	55

** 66 bu manure = 1 metric tonne approximately. 10 tonnes/ha = 4.5 ton/acre*

*** One cubic metre = 220 imperial gallons. One cubic metre per hectare = 90 gallons per acre*

**** F & W denotes fall and winter applied manure;*
Spr denotes spring applied and not covered immediately including surface applications after seeding;
Spr C denotes spring applied manure covered immediately after application.

Time and Method of Application

For most effective use of the nitrogen in manure it should be applied in the spring and covered with soil the same day to prevent loss of ammonia. Immediate covering with soil is estimated to provide 25% more nitrogen to the crop than where the same manure is not covered immediately. Most of the nitrogen loss to the air occurs within the first week after application. Injection of manure between corn rows after seeding, but before the corn is 30 cm high, is one way of preventing nitrogen loss and minimizing the potential for pollution of adjacent streams with phosphate from surface runoff. However phosphate applied after a crop is seeded may not be available to that crop. Phosphate fertilizer requirements should therefore not be adjusted for manure applied after seeding.

Where the manure is applied in the fall more nitrogen is lost (to the air and by leaching) than when spring applied. The nitrogen adjustments should be 50% lower for fall applied manure than for spring-applied manure which is not immediately covered (see table). Phosphate and potash are believed to be equally available from fall- and spring-applied manure.

If manure must be spread in the winter, nitrogen adjustments should be the same as for fall applied. Do not spread manure in winter or early spring on fields that are subject to runoff.

Manure Analysis

The nutrient content of manure varies not only with the type of livestock but with their age, the ration fed, the type of bedding or amount of water added and the method of storing the manure. Chemical analyses will indicate more accurately than this publication the amount of nutrients available for crop production from the particular manure you intend to use, provided a representative sample can be obtained. A manure analysis service is offered through the Department of Land Resource Science, University of Guelph. Samples are analyzed on a cash-with-sample basis.

SEWAGE SLUDGE

Sewage sludge is a useful source of nitrogen, phosphorus and organic matter, provided it is low in heavy metals and applied under approved conditions. Consult OMAF Factsheet 541, *Use of Stabilized Sewage Sludge on Agricultural Land.*

SOIL ACIDITY AND LIMING

The pH scale ranging from 0 to 14 is used to indicate acidity and alkalinity. A pH value of 7.0 is neutral; values below 7.0 are acid and those above 7.0 are alkaline. Most field crops grow well in a soil pH range from 6.0 to 8.0

To correct soil acidity, ground limestone should be broadcast and worked into the soil at rates shown in the accompanying table. Calcitic limestone consists largely of calcium carbonate, and dolomitic limestone is a mixture of both calcium and magnesium carbonates. Dolomitic limestone should be used on soils with a magnesium soil test of 100 or less as it is an excellent source of magnesium for acid soils. On soils with magnesium tests greater than 100, calcitic or dolomitic limestone may be used.

Limestone Quality

Two main factors affect the value of limestone for soil application. One of these is the amount of acid a given quantity of limestone will neutralize when it is totally dissolved. This is called the "neutralizing value" and is expressed as a percentage of the neutralizing value of pure calcium carbonate. In general, the higher the calcium and magnesium content of a limestone the higher the neutralizing value.

The second factor which affects the value of limestone as a neutralizer of acidity is the particle size. Limestone rock has much less surface area to react with acid soil than finely powdered limestone and, hence, it neutralizes acidity much more slowly; so slowly that it is of little value.

In order to compare various limestones that are available, some means of combining the neutralizing value and the particle size is needed.

The index which has been developed for use in Ontario is called the "Agricultural Index".

The Agricultural Index

$$\text{The agricultural index} = \frac{\text{neutralizing value} \times \text{fineness rating}}{100}$$

A limestone which will neutralize 90% as much acid as pure calcium carbonate is said to have a neutralizing value of 90. The calculation of a fineness rating is illustrated in the accompanying table.

Ground Limestone Requirements for Field Crops

Soil pH	Clays and clay loams		Loams and silt loams		Sands, loamy sands and sandy loams	
	Corn and Sorghum	Other Field Crops	Corn and Sorghum	Other Field Crops	Corn and Sorghum	Other Field Crops
	Lime required — tonnes/hectare*					
4.5	11	11	9	9	7	7
4.5-5.0	9	9	7	7	5	5
5.1-5.5	5	7	3	5	2	3
5.6-6.0	0	5	0	3	0	2
≥6.0	0	0	0	0	0	0

** 1 tonne/ha = 0.45 ton/ac*

Example Calculation of the Fineness Rating of a Limestone

Particle Size	% of Sample		Effectiveness Factor		
Coarser than no. 10 sieve*	10	x	0	=	0
no. 10 to no. 60 sieve	40	x	0.4	=	16
Passing through no. 60 sieve	50	x	1.0	=	50
					66

** A no. 10 sieve has wires spaced 2.0 mm, and a no. 60 sieve spaced 0.25 mm apart.*

The Agricultural Index can be used to compare the relative value of different limestones for neutralization of soil acidity[1]. If two ground limestones, A and B, have Agricultural Indices of 50 and 80 respectively, the rate of application of limestone A required for a particular soil will be 80/50 x the rate required for limestone B. Limestone A spread on your farm is worth 50/80 x the price of limestone B per tonne.

Recommendations from the Ontario soil test service are based on limestone with an Agricultural Index of 75. If you have a limestone requirement by soil test of 9 t/ha, and your most suitable source of limestone from a quality and price standpoint has an Agricultural Index of 90, you should apply 75/90 x 9 = 7.5 t/ha. In other words, if you know the Agricultural Index, you can calculate a rate of application specifically for limestone of that quality. This can be done using the following equation:

$$\text{Limestone application rate from soil test} \times \frac{75}{\text{Agr. Index of your limestone}} = \text{rate of application of your limestone}$$

[1] *The Agricultural Index does not provide information about magnesium content. Dolomitic limestone should be used on soils low in magnesium.*

Lowering Soil pH

On soils with pH values below 7.0 it is possible to lower the pH (make the soil more acid) by adding sulfur or aluminum sulfate, but this is not advisable for field crops as it only hastens the time when lime will be required. If the soil pH is above 7.0 it is not advisable and also usually quite impractical to lower the soil pH because of the very large amounts of sulfur or aluminum sulfate required.

SOIL MAGNESIUM

Magnesium is a plant nutrient which is naturally plentiful in many Ontario soils. Soils with magnesium soil tests below 20 (OMAF soil test) require magnesium application for production of most crops. Very few Ontario soils have magnesium tests below 20. If the soil pH is below 6.0, the most effective means of supplying magnesium is by application of dolomitic lime. If the pH is above 6.0 magnesium can be supplied by either magnesium sulfate or sulfate of potash magnesia, which is a mixture of sulface of potash and magnesium sulfate. These latter sources of magnesium are usually quite expensive.

Potassium competes with magnesium for uptake by crops, and potash applications can therefore induce or increase magnesium deficiency. For this reason it is important to monitor soil potassium levels and to carefully control potash fertilizer applications on low magnesium soils.

Crops grown on a number of Ontario soils are low in magnesium to an extent that livestock health is affected although the crops themselves do not suffer from magnesium deficiency. In these situations it is usually much less costly to add magnesium to the animal's diet than to add it to the soil. Soil potassium should be closely monitored, however, and potash applications restricted to requirements as measured by soil test.

FERTILIZER MATERIALS

Nitrogen fertilizer materials are available in dry or liquid forms. Although there are some limitations to use of these materials (see below), in most cases the different sources will produce equal yields. The farmer's choice of material should therefore depend on availability, equipment for handling, and cost per kilogram of nitrogen, plus the cost of application.

A farmer should first calculate the cost per kilogram of nitrogen for various sources delivered to his farm. Depending on the rate of application, the cost per hectare can be determined. Add to this the cost of application per hectare before deciding which nitrogen source to use.

Where separate additions of nitrogen are referred to in the recommendations, kilograms of elemental nitrogen (N), not kilograms of materials, are used. The following tables show the percentage of fertilizer nutrient contained in different materials.

Nitrogen Materials	Form	% Nitrogen (N)*
Ammonium nitrate	Dry	33 to 34
Urea	Dry	45 to 46
Ammonium sulfate	Dry	20
Aqua ammonia	Liquid**	20
Ammonium nitrate-urea	Liquid	28
Ammonium nitrate-urea	Liquid	32
Ammonia-ammonium nitrate-urea	Liquid**	41
Ammonia-ammonium nitrate	Liquid**	41
Anhydrous ammonia	Liquid**	82

Phosphate Materials	% Phosphate (P_2O_5)*
Single superphosphate	18 to 20
Triple superphosphate	44 to 46
Monoammonium phosphate	50 to 54
Diammonium phosphate (18-46-0)	46

Potash Materials	% Potash (K_2O)*
Muriate of potash	60 to 62
Sulfate of potash	50
Sulfate of potash-magnesia (11% Mg)	22
Potassium nitrate (13-0-44)	44

** Kilograms of N, P_2O_5, or K_2O supplied in 100 kg of material.*

*** Liquid under pressure.*

TOXICITY OF FERTILIZER MATERIALS

All fertilizer salts are toxic to germinating seeds and to plant roots if applied in sufficient concentration near the seed. Fertilizers vary in toxicity per unit of plant nutrient due to: (1) differences in the amount of salts contained in the fertilizer per unit of plant nutrient, (2) differences in solubility of the salts in the soil, and (3) a few specific materials or elements are particularly toxic (for example, anhydrous ammonia and boron). Phosphate fertilizers are usually low in toxicity because a large portion of the phosphate is precipitated in the soil before it can reach the plant roots. The concentration of phosphorus in soil solution at any one time is very low.

TOXICITY OF COMMON FERTILIZER MATERIALS

Nitrogen Fertilizers

Ammonium nitrate, monoammonium phosphate and ammonium sulphate are similar in toxicity and much safer than anhydrous ammonia, aqua ammonia or urea.

Diammonium phosphate is more toxic than monoammonium phosphate but less toxic than urea. More care should be taken, particularly with sensitive seeds and on coarse-textured soil (sand and sandy loam), than is required with ammonium nitrate, or monoammonium phosphate.

Because anhydrous ammonia and aqua ammonia are extremely toxic fertilizers, they should not be placed near seeds. It is preferable to make pre-plant applications crossways to the direction in which the crop will be planted.

Urea is toxic when banded with or near the seed but is safe when broadcast at rates normally used. Fertilizers containing more than half as much nitrogen as phosphate frequently contain urea.

Phosphate Fertilizers

Most common phosphate fertilizers are not very toxic to seeds and plants and no limit is normally set for the safe rate which may be applied with, or near, the seed of field crops.

Diammonium phosphate is more toxic than other phosphate fertilizer — see above under nitrogen fertilizers.

Potash Fertilizers

Muriate of potash (KCl) is the most common source of potassium in fertilizers, and is less toxic per unit of plant nutrients than most nitrogen fertilizers.

Sulphate of potash (K_2SO_4) is less toxic than muriate of potash.

Sulphate of potash-magnesia has approximately the same toxicity per unit of potassium as muriate of potash.

Potassium nitrate is one of the safer sources of potassium when considered as a nitrogen source as well.

Fertilizers Containing Micronutrients

Fertilizers containing micronutrients (boron, copper, iron, manganese or zinc) are more toxic than the same grades without micronutrients and maximum safe rates should be reduced. Boron is particularly toxic.

SECONDARY AND MICRONUTRIENTS

If secondary or micronutrients are proven to be needed (by soil and/ or tissue tests) then the most common sources of these are:

Magnesium (Mg)		
— Dolomitic Limestone	6-13%	Mg
— Epsom Salts (Magnesium sulphate)	9.6%	Mg
— Sulphate of Potash — Magnesium	11.0%	Mg
Boron (B)		
Various boron sources are available.	8-21%	B
Copper (Cu)		
Copper Sulphate	13-52%	Cu
Copper Chelates	9-13%	Cu
Copper Oxide	60-80%	Cu
Manganese (Mn)		
Manganese Sulphate	26-28%	Mn
Manganese Chelates	9-12%	Mn
Molybdenum (Mo)		
Sodium Molybdate	39%	Mo
Zinc (Zn)		
Zinc Sulphate	36%	Zn
Zinc Chelates	9-14%	Zn
Zinc Oxide	78-80%	Zn

Various fertilizer companies have available, in addition to the above micronutrient sources, premixes containing one or more of the above micronutrients.

Individual Factsheets are available on some of these micronutrients. For a list of these see page 59 of this publication.

Guidelines for Safe Rates of Nutrients Applied at Seeding

Fertilizer toxicity varies widely, depending on the amount of soil moisture. To insure completely safe rates of banded fertilizer for all seeding conditions would require extremely low rates of application. The maximum safe rates suggested here will probably reduce or delay germination, or retard growth in up to 10% of the cases where they are used. In most cases, it is advisable to use lower rates of fertilizer at seeding than those listed in the following table. If fertilizer requirements are high, it may be better to broadcast most of the fertilizer required and to band only a small portion at seeding. Fertilizers containing the micronutrients (boron, copper, iron, manganese and zinc) are more toxic, and the safe rates recommended will be lower than those shown in this table.

	Maximum Safe Rates of Nutrients
SPRING OATS OR BARLEY (fertilizer with the seed)	
Sands and Sandy Loam Soils	35 kg nitrogen or 55 kg (nitrogen + potash) per hectare. If **diammonium phosphate** (18-46-0) is the N source, 20 kg nitrogen or 35 kg (nitrogen + potash) per hectare. If **urea** is the N source, 10 kg nitrogen or 30 kg (nitrogen + potash) per hectare*.
Loams, Silt or Clay Loams	45 kg nitrogen or 70 kg (nitrogen + potash) per hectare. If **diammonium phosphate** (18-46-0) is the N source, 30 kg nitrogen or 55 kg (nitrogen + potash) per hectare. If **urea** is the N source, 10 kg nitrogen or 30 kg (nitrogen + potash) per hectare*.
WINTER WHEAT OR BARLEY (fertilizer with the seed)	
All Soils	15 kg nitrogen or 30 kg (nitrogen + potash) per hectare. **Diammonium phosphate** (18-46-0) or **urea** should not be drilled with the seed of fall-seeded cereals*.
CORN (fertilizer with the seed)	
All Soils	7 kg (nitrogen + potash) per hectare in one metre rows. **Diammonium phosphate** or **urea** should not be applied with the seed of corn. At row widths other than one metre, the rate may be adjusted to provide the same maximum concentration in the row (in 50 cm rows the safe rate = $\frac{100}{50}$ x 7 = 14 kg (nitrogen + potash) per hectare).
CORN (fertilizer banded 5 cm to the side and 5 cm below the seed)	
All Soils	60 kg nitrogen or 90 kg (nitrogen + potash) per hectare. If **urea** is the N source, 30 kg nitrogen or 60 kg (nitrogen + potash) per hectare. At row widths other than one metre, the rate may be adjusted to provide the same maximum concentration in the row (in 50 cm rows the safe rate = $\frac{100}{50}$ x 60 = 120 kg N per hectare).
FLAX AND CANOLA (no fertilizer with seed)	
All Soils	Rates recommended are normally safe when broadcast.
PEAS, BEANS, AND SOYBEANS (no fertilizer with seed)	
All Soils	**(fertilizer banded 5 cm to the side and 5 cm below the seed)** 30 kg nitrogen or 90 kg (nitrogen + potash) per hectare. Rates recommended are normally safe when broadcast.

* *Fertilizers containing more than half as much nitrogen as phosphate (e.g. 16-16-16) frequently contain urea. Note that fertilizers containing urea are not suitable for banding at seeding in many cases.*

GENERAL INFORMATION

Brands of a pesticide from different companies often have different concentrations of the same chemical in them. Consequently, if you use one with a concentration different from that listed in the recommendations in this publication, you will need to adjust the rate of application so that you will be applying the same amount of actual chemical (active ingredient).

PRECAUTIONS WITH PESTICIDES

Read the following points before using any pesticides:

1. Always read the label before opening pesticide containers and follow all precautions and directions.
2. Never smoke, chew tobacco, or eat while handling or applying pesticides. DO NOT carry such items in clothes used for spraying.
3. Always wear neoprene gloves to handle the concentrate. Wear a mask to reduce pesticide inhalation especially when handling dusty formulations or volatile concentrates. Avoid inhaling spray droplets, dust or fumes by wearing a mask.
4. Avoid spilling pesticides on skin or clothing.
5. Wear freshly laundered clothes each day.
6. Avoid contamination of water supplies, wells, ponds, streams, etc. with pesticides when filling or flushing out spray equipment. Never fill a sprayer directly from a stream or pond, unless the unit is equipped with an anti-backflow device to prevent siphoning.

If Accidents Occur

1. If an accident occurs, remove contaminated clothing immediately, and wash contaminated skin thoroughly with soap and water. Wash clothing before reuse.
2. If clothing becomes wet with a pesticide, when spraying, remove it immediately. When the spray operation is complete, remove contaminated clothes, have a bath or shower and put on freshly laundered clothing.
3. Clean up any pesticide spills immediately. Use dry soil, sawdust or other absorbent material to remove excess liquid. If the spill is major, contact the nearest office of the Pesticide Control Service for advice (see page 58).
4. If symptoms of illness occur during or shortly after handling or applying a pesticide, get the patient to a hospital immediately. If possible, take a labeled container of the pesticide with you. (See Emergency procedure for Pesticide Poisoning on page 49).
5. If a well becomes contaminated, follow clean up instructions in OMAF Factsheet, *Pesticide Contamination of Farm Water Supplies*, Agdex 607.

Special Instructions

It should be emphasized that all pesticides are toxic and must be handled safely. In addition a number of pesticides (insecticides, fungicides and herbicides) have major deficiencies in their toxicological information because of the many tests that were conducted by the Industrial Biotest Laboratory (IBT), some of which were invalid. Replacement studies are currently being conducted by the respective registrants. Those handling and applying these chemicals must pay special attention to the precautions outlined above.

At the time of publication, pesticides included in this publication requiring additional studies are as follows:

CSA Common Name	Trade Name
captan	Captan, Orthocide
carbofuran	Furadan
chlorothalonil	Bravo
diazinon	Basudin
disulfoton	Di-Syston
endosulfan	Thiodan
fensulfothion	Dasanit
metiram	Polyram

Storage

1. Keep pesticides out of the reach of children, irresponsible persons, pets, and livestock. Store them in a room away from the home, food, and feed and keep the room locked. Post pesticide storage area notices.
2. Always store pesticides in original containers and keep them tightly closed. Never put pesticides in unmarked containers. See OMAF Factsheet Agdex 607, *Farm Storage of Pesticides*.

Disposal of Pesticide Containers & Contaminated Material

1. Containers from pesticide packages and any paper or other material used to clean up spills should be buried or burned. Make sure that people and animals are kept away from the smoke and that the smoke is not directed toward buildings, highways, roads, or public outdoor areas.
2. Rinse all empty metal or glass containers three times with water, add washings to the spray tank. Dispose of the containers by puncturing or breaking and burying the container in such a manner that it is covered by at least 50 cm of soil and is not near any watercourse or water table.

Protective Clothing when Using Pesticides Outdoors

1. When measuring and mixing pesticides, wear neoprene or rubber gloves, rubber boots, a protective apron or coveralls, and protective eyeshields. (Inexpensive disposable aprons, shirts, pants, and headwear are also now available.)
2. Wash all protective clothing after use.

Wear a chemical cartridge respirator with a dual chemical cartridge when mixing or applying pesticides. The following respirators are recommended for outside use against light pesticide concentrations:

Willson Agri-Tox 2 Respirator with R21 cartridges and R15 filters.

Norton 7549 or 7549 M Respirator with 7500-21 cartridges and 7500-23 filters.

MSA 448848 or 460560 Respirator with 464025 combination cartridges.

American Optical R4058, R5058 or R6058 Respirator with R50 filter/cartridges.

Pulmosan 241 Respirator with 241-7 filter / cartridges.

Safety House of Canada 236-G100-F104 Respirator with G100 cartridges and F104 filters.

H.S. Cover 1482 Respirator with 100 cartridges and 104 filters.

They should always be worn when applying pesticides listed in the "extremely toxic" or "highly toxic" categories in this publication. Change cartridges according to manufacturer's directions.

A powered chemical cartridge respirator, W-262 GENERAL PURPOSE SYSTEM, is now available from the 3M Company, and is suitable for vehicle mounting.

> Complete information on protective equipment may be found in *Personal Protective Equipment for Pesticide Users*, available at offices of the Pesticide Control Service, your pesticide dealer, and offices of the Ontario Ministry of Agriculture and Food.

Disposable Plastic and Waterproof Clothing

Plastic aprons, disposable hoods, laboratory coats, boot covers, coveralls, protective female smocks, and hat covers are now available at a reasonable price. A special two-piece coverall set for easy movement and comfort is also available.

Any of the above are available direct from TITAN Disposables Limited, 8530 Esplanade Ave., Montreal, P.Q., H2P 2R8. Telephone (514) 381-2301. Telephone or write for prices and further information.

Protective clothing is also available from many of the safety supply companies.

EMERGENCY PROCEDURES FOR PESTICIDE POISONING

If a person suspects poisoning from exposure to a pesticide by swallowing, inhalation, or contact with skin or eyes, read the label on the pesticide container and carry out the first-aid treatment suggested.

If a pesticide has come in contact with the skin or has been spilled on clothing, remove the clothing and wash the skin thoroughly with soap and warm water.

If a pesticide has come in contact with the eyes, rinse them with plenty of water for 15 minutes.

IMMEDIATELY AFTER THE FIRST-AID TREATMENT HAS BEEN GIVEN, WRAP THE PATIENT IN A COAT OR BLANKET AND RUSH HIM TO THE NEAREST HOSPITAL, TAKING THE LABELED PESTICIDE CONTAINER WITH YOU.

First-Aid Treatment

The Occupational Health and Safety Division, Ministry of Labour, 400 University Ave., Toronto, M7A 1T7, has physicians available for consultation on first-aid information and advice. They can be contacted in the following manner:

Between the hours of 8:00 a.m. and 5:00 p.m., Monday to Friday, telephone (416) 965-3610.

During weekends, public holidays and non-office hours telephone (416) 965-1211 and ask for the "on-call" physician.

SPRAYERS

Herbicide sprayers, capable of delivering sufficient litres per hectare for adequate coverage, are satisfactory for applying emulsion-type insecticides. However, if 2,4-D or related herbicides have been used in them, such sprayers will have to be cleaned thoroughly or foliage is apt to be damaged. The detergent recommended should contain ammonia for best results.

For applying the wettable powder formulations, a high-capacity (450 L/ha), high-pressure piston pump sprayer with an agitator, is recommended. Keep in mind that the higher the pressure the greater the danger of drift to other crops.

Calibrate your sprayer at least twice during the growing season. The wear on nozzles and other parts will alter the amount of spray delivered at the usual speed and pressure.

For information on calibration, see OMAF Publication 75, *1982 Guide to Chemical Weed Control.*

APPLICATION BY AIRPLANES OR HELICOPTERS

Aerial applicators must be licensed by the Ontario Ministry of the Environment to apply pesticides. In addition, permits are required from the Ontario Ministry of the Environment under the authority of The Pesticides Act 1973 for the application of Schedule 1 and 5 pesticides, and Schedule 2 hormone-type herbicides. The area will be inspected by ministry personnel to ensure safety of application.

It is an offense under the Federal Pest Control Product Act to use a control product under unsafe conditions. Precautionary practices must be heeded at all times to prevent drift. Extra precautions should be taken when using insecticides applied by air, especially those known to be toxic to honeybees, e.g. Sevin (carbaryl.)

Applications should not be made if the wind is blowing. Some drift occurs even on the stillest day and to keep it to a minimum, apply pesticides in the evening or early morning.

Be sure that the product to be used is specified, along with rate of application, in the contract.

PESTICIDE DRIFT

Pesticide drift can leave unwanted residues on adjacent crops, be a hazard to people and livestock nearby, or reduce the amount of material in the target area as to be ineffective. Those applying pesticides should make every effort to minimize or prevent pesticide spray drift by paying attention to:

1. correct calibration and maintenance of spray equipment;
2. correct operation of the equipment;
3. being aware of the toxicity of the pesticide in use; and
4. being aware of the weather conditions.

For more information consult OMAF Factsheet, *Pesticide Drift*, Agdex 607, or Canadex 607 *Pesticides: Effects of Drift and Droplet Size.*

PROTECT HONEYBEES

Because bees may be killed, do not apply insecticides that are toxic to bees (see list and remarks, on pages 52 and

53) on crops or wild plants that are in bloom. Sevin (carbaryl) is extremely toxic to honeybees. If insect control is necessary while crops are in bloom or corn is shedding pollen, spray only in the evening or in the early morning when bees are not in the field. Do not spray when the wind will carry the insecticide to adjacent bee pastures or into the general area of apiaries.

WHEN PLANNING TO APPLY A PESTICIDE, ADVISE LOCAL BEEKEEPERS SO THEY HAVE AN OPPORTUNITY TO MOVE COLONIES OUT OF THE DANGER AREA. YOUR LOCAL AGRICULTURAL REPRESENTATIVE HAS A LISTING OF THE BEEKEEPERS IN YOUR AREA.

SEED TREATMENTS

Seed dressings or treatments are poisonous to man and livestock. Do not inhale the fumes or dust when treating or handling treated seed. Wash all residues of these chemicals from the skin after seed treatment is completed. Chemically treated seed is poisonous. Never feed surplus seed to livestock. Destroy all bags that have held treated seed as recommended in the container disposal section above.

RESIDUES ON CROPS TO BE HARVESTED, FED OR GRAZED

Certain pesticide residues disappear quickly after application; others persist in poisonous form for much longer periods. When crops with persistent residues are fed to livestock the poisons tend to accumulate in the body fat and milking cows will excrete them, or their metabolic products in the milk. Young calves, heifers, and dry cows will store these in body fat and secrete them when they freshen months later. Do not use residues from thiodan-treated crops for bedding. To avoid residue problems, use (1) the proper chemical, (2) the recommended dosage, and (3) observe the proper interval to harvest.

REENTRY INTO TREATED AREAS

Pesticide poisoning may occur where workers enter fields too soon after pesticides have been applied. Such poisoning can result from handling treated plants or from inhalation of pesticide vapors.

The pesticdes listed below are those for which a specific minimum interval must be observed from the time of application to the time of working in the crop. For some pesticides, e.g. parathion, the label carries a warning regarding working in treated crops. **Follow these recommendations**. Where no label warnings are provided, the following minimum intervals are recommended. Minimum reentry time of 24 hours is indicated thus[1]. Minimum reentry time of 48 hours is indicated thus[2].

24 Hours	48 Hours
[1]Lannate	[2]Guthion
	[2]Furadan

INSECTICIDE NOTES

Relative Toxicity of Crop Insecticides to Man

Extremely Toxic

Birlane (chlorfenvinphos)
Counter (terbufos)
Dasanit (fensulfothion)
Di-syston (disulfoton)
Dyfonate (fonofos)
Furadan (carbofuran)
Guthion (azinphos-methyl)
Lannate (methomyl)
Thimet (phorate)

Extremely toxic

These pesticides are dangerous through inhalation, skin contact, or if taken by mouth. A few grams can be fatal. Wear protective clothing (page 48), avoid mixing in windy areas, dispose of containers properly (page 48) and always wash and change clothing immediately after use.

Moderately Toxic

Basudin (diazinon)
Cygon (dimethoate)
Imidan (phosmet)
Lorsban (chlorpyrifos)
Thiodan (endosulfan)

Moderately toxic

These pesticides are dangerous if handled carelessly. Caution is required to ensure that they are not taken internally or allowed to contact bare skin. Wear protective clothing when mixing or working with them in confined areas. Avoid breathing the vapors. Wash and remove clothing after applying these materials. Dispose of containers properly (page 48).

Pesticides listed in this publication and not appearing on this list have lower toxicities and should be handled with all precautions listed on the label. Even the most toxic pesticides can be used safely by following all the directions and precautions for proper use as listed on the product label.

Distributors The addresses and phone numbers of companies supplying insecticides are:

Distributor	Address	Phone
Barlett	Box 490, Beamsville, Ont. L0R 1B0	(416) 563-8261
Chipman	P.O. Box 9100, Stoney Creek, Ont. L8G 3Z1	(416) 643-4123
Niagara	1274 Plains Rd. E., Burlington, Ont. L7R 3Z1	(416) 634-2355
Pfizer	1 Wilton Grove Rd., Box 2005, London, Ont. N6A 4C6	(519) 681-2173
UCO and IPCO	Suite 801, 151 City Centre Drive, Mississauga, Ont. L5A 3A1	(416) 270-0703
Green Cross	6860 Century Ave., Mississauga, Ont. L5N 2W5	(416) 821-4430

Formulations Pesticides may be in either liquid or solid form.

Liquids
E or EC — Emulsifiable Concentrates
F — Flowable
LC — Liquid Concentrate
S — Sprayable
SC — Sprayable Concentrate

Solids
WP — Wettable Powder
G — Granular

Fungicides for Field Crops

Active Ingredient	Fungicide		% Active Ingredient
SEED TREATMENTS			
metiram	Polyram — Diazinon Dust		7
	Polyram 7		7
	Polyram liquid		22.5
	Polyram — Lindane		53.3
captan	Co-op D-L-C		15
	Pfizer D-L-C		15
	B-3 (D-L-C)		33.5
	Captan Flowable		30
	Captan 30 — Methoxychlor 3 (flowable)		30
	Gammasan		10
	Drillbox Lindasan		10
thiram	Thiram 75% D		75
	Vitaflo Dual Purpose		8.9
	Vitaflo P		38.8
	Vitaflo Dual Purpose Powder		28.9
maneb	Agrox Flowable		25
	Agrox N-M		50
	Co-op N-M		50
	Mergamma N-M		37.5
carbathiin	Vitaflo Dual Purpose		10.1
	Vitaflo 280		10.1
	Vitaflo 250		25.3
TCMTB	Busan 30		30
Captan + Thiophanate methyl + Diazinon	DCT	Captan	18
		Thiophanate methyl	14
		Diazinon	6
Benomyl + Captan + Diazinon	IF-PLUS	Benomyl	17.5
		Captan	25
		Diazinon	12.5
FOLIAR SPRAYS			
benomyl	Benlate 50% WP		50
dichloran	Botran		75
thiophanate methyl	Easout 70% WP		70
chlorothalonil	Bravo 500		50
	Bravo W-75		75
ethirimol	Milgo E		280 g/L

Insecticide Notes

Name	Insecticide Classification	Formulation	Days to Harvest	Relative Toxicities*	Aerial Application	Cost** per ha, $	Distributors	Use and Remarks
Basudin (diazinon)	organo phosphorus	50 WP	7	Moderately toxic	Yes	12.15	Chipman Green Cross Niagara Pfizer	Alfalfa, corn, field beans, peas. Toxic to bees.
Birlane (chlorfenvinphos)	organo phosphorus	10% G	planting time only	Extremely toxic	No	30.35 - 40.40	Shell Pfizer, UCO	Corn
Counter (terbufos)	organo phosphorus	15 G	planting time only	Extremely toxic	No	23.90	Pfizer	Corn
Cygon (dimethoate)	organo phosphorus	4.8 E	2 Alfalfa 7 Beans	Moderately toxic	Yes	Alfalfa: 7.10 Beans: 9.00 - 12.90	Bartlett Chipman Green Cross Niagara Pfizer, UCO	Alfalfa, field beans. Toxic to bees.
Dasanit (fensulfothion)	organo phosphorus	15% G	planting time only	Extremely toxic	No	13.70 - 26.60	Chipman Green Cross Niagara Pfizer, UCO	Corn
Di-Syston (disulfoton)	organo phosphorus	15% G 7.2 LC	planting time only	Extremely toxic	No	21.60	Green Cross	Corn
Dyfonate (fonofos)	organo phosphorus	20% G	planting time only	Extremely toxic	No	18.80 - 25.25	Chipman UCO	Corn
Dylox (trichlorfon)	organo phosphorus	80% SP 420 Liquid	21	Lower Toxicity	Yes	7.30 10.75	Agrospray Niagara, UCO	Relatively safe to bees.
Furadan (carbofuran)	carbamate	10% G 4.8 F	planting time only 7	Extremely toxic	Yes, Permit Required	Corn: 20.85 - 27.75 Alfalfa: 2.95 Corn: 11.35	Green Cross Niagara	Corn, alfalfa. Toxic to bees.
Guthion (azinphos-methyl)	organo phosphorus	2.4 SC 50% WP	3 Beans 21 Alfalfa 30 Grain	Extremely toxic	Yes, Permit Required	16.70 - 17.10 16.60	Bartlett Chipman Green Cross Niagara Pfizer	Field beans, soybeans. Toxic to bees.

Imidan (phosmet)	organo phosphorus	50% WP	7	Moderately toxic	Yes	14.60	Chipman	Alfalfa. Toxic to bees.
Lannate (methomyl)	carbamate	L	21	Extremely toxic	Yes	Armyworms 18.30	Chipman Pfizer Niagara	Grain
Lorsban (chlorpyrifos)	organo phosphorus	4 C 25 WP 15 G	100	Moderately toxic	No	Cutworms 28.40 Rootworms	Pfizer	Corn
Malathion	organo phosphorus	50% EC 25% WP	7	Lower toxicity	Yes	10.30 - 13.90 (alfalfa, weevil, cereal leaf beetle, & grasshoppers) 14.40 - 22.80 (armyworm) 15.20 (bean beetle & leafhopper)	Bartlett Chipman Green Cross Niagara Pfizer UCO	Alfalfa, grain crops, field beans, soybeans, Toxic to bees.
Methoxychlor	organo chlorine	2.4 EC 50% WP	7	Lower toxicity	Yes	23.00 17.00	Bartlett Chipman Niagara UCO	Alfalfa, grain crops, Relatively safe to bees.
Sevin (carbaryl)	carbamate	50% WP 80 S 85% WP	1 Corn 3 Pea 14 Grain 1 Alfalfa 1 Bean	Lower toxicity	Yes	11.80 - 12.50 (green cloverworm, cereal leaf beetle armyworm) 18.50 (grasshoppers cornborer)	Bartlett Chipman Niagara Pfizer UCO Green Cross	Alfalfa, corn field beans, soybeans, grain crops. Extremely toxic to bees.
Thimet (phorate)	organo phosphorus	15% G	planting time only	Extremely toxic	No	23.00	Green Cross Pfizer UCO	Corn
Thiodan (endosulfan)	organo chlorine	4 EC	2	Moderately toxic	Yes	13.60	Chipman Green Cross Pfizer Niagara	Field beans, soybeans. Toxic to bees.
Thuricide and Dipel (Bacillus thuringiensis)	Biological	HPC SC	0	Lower toxicity	Yes	19.40 8:00 - 12.50	Chipman Green Cross	

* *See Insecticide Notes. Relative Toxicity, page 50.*

** *Cost per hectare and availability will differ across the province. 1981 costs are quoted since 1982 prices were not available at time of printing.*

GENERAL INFORMATION

METRIC CONVERSION INFORMATION

Metric Equivalents

Length

inch = 2.54 cm	millimetre = 0.04 in.
foot = 0.30 m	centimetre = 0.39 in.
yard = 0.91 m	metre = 3.28 ft
mile = 1.61 km	kilometre = 0.62 mile

Area

square inch = 6.45 cm^2	cm^2 = 0.16 sq in.
square foot = 0.09 m^2	m^2 = 1.20 sq yd
square yard = 0.84 m^2	km^2 = 0.39 sq mile
square mile = 2.59 km^2	ha = 2.47 acres
acre = 0.40 ha	

Volume (dry)

cubic inch	= 16.38 cm^3	cm^3	= 0.06 cu in.
cubic foot	= 0.03 m^3	m^3	= 35.31 cu ft
cubic yard	= 0.76 m^3	m^3	= 1.31 cu yd
bushel	= 36.37 L		
board foot	= 0.0024 m^3		

Volume (liquid)

fluid ounce (Imp)	= 28.41 mL	litre	= 35.2 fluid oz (Imp)
pint	= 0.57 L	hectolitre	= 26.42 gal (U.S.)
gallon (Imp)	= 4.55 L		= 22.00 gal (Imp)

Weight

ounce	= 28.35 g	gram	= 0.035 oz
pound	= 453.6 g	kilogram	= 2.20 lb
ton	= 0.91 tonne	tonne	= 2205 lb

Proportion

1 gal/acre	= 11.23 L/ha	1 L/ha	= 14.25 fluid oz/acre
1 lb/acre	= 1.12 kg/ha	1 kg/ha	= 14.5 oz/acre
1 lb/sq in.	= 6.90 kilopascals (kPa)	1 metric tonne/ha	= 0.45 ton/acre
1 ton/acre	= 2.24 metric tonne/ha	1 kilopascal	= 0.145 lb/sq in.

gram = g	metre = m	centimetre = cm	hectare = ha	millilitre = mL
kilogram = kg	kilometre = km	millimetre = mm	litre = L	hectolitre = hL

WEIGHTS AND MEASURES (METRIC)

1 litre = 1000 millitres
= volume of a cube, 10 cm x 10 cm x 10 cm
1 litre of water weighs 1 kilogram
1 tonne = 1000 kilograms = 1,000,000 grams
1 kilogram = 1000 grams
1 hectare = 10,000 square metres
= area of a square 100 metres x 100 metres

1 centimetre = 10 millimetres
1 metre = 100 centimetres = 1000 millimetres
1 kilometre = 1000 metres
1 kilometre/hour = 16.6 metres/minute

WEIGHTS AND MEASURES (IMPERIAL)

1 imperial gallon = 4 quarts = 8 pints = 160 fluid ounces
= approx 1.2 U.S. gallons
1 U.S. gallon = approximately 5/6 imperial gallon
1 imperial gallon of water weighs 10 pounds
1 imperial quart = 2 pints = 40 fluid ounces
1 imperial pint = 20 fluid ounces = 2-1/2 measuring cups
1 kitchen measuring cupful = 8 fluid ounces
3 teaspoonfuls = 1 tablespoon = 1/2 fluid ounce

1 mile = 5,280 feet = 1,760 yards = 320 rods
1 rod = 16.5 feet = 5.5 yards
1 yard = 3 feet = 36 inches
1 foot = 12 inches
1 acre = 43,560 square feet =
4,840 square yards = 160 square rods
1 square yard = 9 square feet
1 square foot = 144 square inches
1 mile an hour = 88 feet a minute

CONVERSION FACTORS, METRIC TO IMPERIAL

	When you know	Symbol	Multiply by	To Find
LENGTH	centimetres	cm	0.4	inches
	metres	m	3.3	feet
	metres	m	1.1	yards
	kilometres	km	0.62	miles
AREA	square centimetres	cm^2	0.16	square inches
	square metres	m^2	10.8	square feet
	square metres	m^2	1.2	square yards
	square kilometres	km^2	0.40	square miles
	hectares	ha	2.47	acres
WEIGHT	grams	g	0.035	ounces
	kilograms	kg	2.2	pounds
	tonnes	t	1.1	tons
VOLUME	millilitres	mL	0.035	fluid ounces
	litres	L	1.76	pints
	litres	L	0.88	quarts
	litres	L	0.22	gallons
	cubic metres	m^3	35.3	cubic feet
	cubic metres	m^3	1.3	cubic yards
PRESSURE	kilopascals	kPa	0.14	pounds per square inch
PROPORTION	litres per hectare	L/ha	14.25	fluid ounces per acre
	litres per hectare	L/ha	0.09	gallons per acre
	kilograms per hectare	kg/ha	0.9	pounds per acre
	tonnes per hectare	t/ha	0.44	tons per acre
	plants per hectare		0.4	plants per acre

SEEDS PER UNIT OF FORAGE SPECIES

Crop	Seeds per kg
Alfalfa	440,000
Red Clover	605,000
White Clover	1,760,000
Bird's-foot Trefoil	935,000
Sweet Clover	572,000
Alsike	1,540,000
Timothy	2,706,000
Orchard Grass	1,439,000
Bromegrass	300,000
Meadow & Tall Fescue	506,000
Perennial Rye Grass	500,000
Reed Canary Grass	1,173,000
Bluegrass	4,790,000

SEEDING RATES

Crop	kg/ha	
Wheat (Winter & Spring)	100-130	
Oats	55-75	not seeded down
	40-55	seeded down
Barley (Winter & Spring)	80-110	
Rye	70-95	small seeded varieties
	120-160	large seeded varieties
Triticale (OAC Wintri)	75-100	
Corn	11-22	
Beans (White)	40-45	
Soybeans	65-100	
Peas (Field)	130-200	
Buckwheat	55	
Flax (for seed)	40	
Canola	5.5-8	
Sunflower	6-8	
Mustard	8-11	
Turnips	0.6	
Rape (forage)	1.75 in rows	
Kale	2.25 in rows	
	7 broadcast	
Sorghum-sudan grass	13-17	

ONTARIO MINISTRY OF AGRICULTURE AND FOOD

Western Ontario Offices

County	Agricultural Representatives		Soils and Crops Specialists	
Essex Kent	46 Fox St., Essex, N8M 2S2 Box 726, 435 Grand Ave., W. Chatham, N7M 5L1	519-776-7361 519-354-2150	John Schleihauf c/o RCAT, Ridgetown N0P 2C0	519-674-5456
Lambton	Box 730, Petrolia, N0N 1R0	519-882-0180		
Norfolk Elgin	Box 587, Simcoe, N3Y 4N5 594 Talbot St., St. Thomas, N5P 1C7	519-426-7120 519-631-4700	David Morris 594 Talbot St., St. Thomas, N5P 1C7	519-631-4700
Middlesex	195 Dufferin Ave., London, N6A 1K7	519-434-6811		
Oxford Brant	Box 666, Woodstock, N4S 7Z5 207 Greenwich St., Brantford, N3S 2X7	519-537-6621 519-759-4190	Harvey Wright c/o Crop Science University of Guelph, Guelph, N1G 2W1	519-824-4120 Ext. 2513
Wentworth	RR 1, Ancaster, L9G 3K9	416-527-2995		
Huron Perth	Box 159, Clinton, N0M 1L0 Box 398, 413 Hibernia St. Stratford, N5A 6T3	519-482-3428 519-271-0280	Patrick Lynch, Box 398, 413 Hibernia St., Stratford, N5A 6T3	519-271-0280
Haldimand Niagara, North Niagara, South	Box 129, Cayuga, N0A 1E0 Vineland Station, L0R 2E0 574 South Pelham St., Welland, L3C 3C6	416-772-3381 416-562-4142 416-732-7552	K. Bereza R.R. 1, Ancaster, L9G 3K9	416-527-2995
Wellington Waterloo	Box 159, Fergus, N1M 2W7 279 Weber St. N., Waterloo N2J 3H8	519-846-5371 519-884-5390	High Martin c/o Land Resource Science University of Guelph, Guelph, N1G 2W1	519-824-4120 Ext. 2454
Bruce Grey Dufferin	Box 1330, Walkerton, N0G 2V0 181 Toronto St. S., Markdale, N0C 1H0 RR 4, Orangeville, L9W 2Z1	519-881-3301 519-986-2040 519-941-3830	R.A. Upfold Box 1330, Walkerton, N0G 2V0	519-881-3301
Halton Peel York	17 Wilson Dr., Milton, L9T 3J7 3 Elizabeth St. S., Brampton, L6Y 1P7 Newmarket Plaza, Newmarket, L3Y 2N1	416-878-2314 416-451-5474 416-895-4519	Henry Olechowski Newmarket Plaza, Newmarket, L3Y 2N1	416-895-4519
Simcoe, North Simcoe, South	Box 340, Elmvale, L0L 1P0 Box 370, Alliston, L0M 1A0	705-322-2231 705-435-5521	C.H. Kingsbury, Box 370, Alliston, L0M 1A0	705-435-5521

Seeds and Weeds Specialists

Western Ontario	W.D. Taylor, Crop Science Department, University of Guelph, Guelph, N1G 2W1 — 519-824-4120, Ext. 2513
Central Ontario	R.D. McLaren, Crop Science Department, University of Guelph, Guelph, N1G 2W1 — 519-824-4120, Ext. 2513
Eastern Ontario	Bruce Archibald, Ontario Government Bldg., Box 2004, Kemptville, K0G 1J0 — 613-258-3411
Northern Ontario	Walker Riley, 222 McIntyre St. W., North Bay, P1B 2Y8 — 705-474-3050

Insect and Disease Specialists

Insects	K. Bereza, RR 1, Ancaster, L9G 3K9 — 416-527-2995
Diseases	C. Hunter, Research Station, P.O. Box 587, Simcoe, N3Y 4N5 — 519-426-7120

Tobacco Specialists

M.C. Watson N.W. Sheidow	Research Station, Box 186, Delhi, N4B 2W9 — 519-582-1950

Eastern Ontario Offices

County	Agricultural Representatives		Soils and Crops Specialists	
Ontario	Box 309, Uxbridge, L0C 1K0	416-852-3328	Neil Moore	705-324-6125
Victoria	322 Kent St. W., Lindsay, K9V 2Z9	705-324-6125	322 Kent St. W., Lindsay, K9V 2Z9	
Durham	234 King St. E., Bowmanville, L1C 1P5	416-623-3348		
Peterborough	55 George St. N., Peterborough, K9J 3G2	705-745-2403		
Northumberland	Box 820, Brighton, K0K 1H0	613-475-1630		
Hastings	Box 340, Stirling, K0K 3E0	613-395-3393	Howard Lang	613-476-3224
Lennox & Addington	41 Dundas St. W., Napanee, K7R 1Z5	613-354-3371	Box 470, Picton, K0K 2T0	
Prince Edward	Box 470, Picton, K0K 2T0	613-476-3224		
Frontenac	Box 651, 1055 Princess St., Kingston, K7L 1H3	613-544-1995		
Leeds	Box 635, Brockville, K6V 5V8	613-342-2124	Bruce Archibald	
Grenville	Box 2004, Kemptville, K0G 1J0	613-258-3411	Box 2004, Kemptville	613-258-3411
Dundas	Box 488, Winchester, K0C 2K0	613-774-2313	K0G 1J0	
Stormont	Box 655, 109-11th St. W., Cornwall, K6H 5T3	613-933-1581		
Lanark	10 Sunset Blvd., Perth, K7H 2Y2	613-267-1063	Gerald Winnicki	613-258-3411
Renfrew	315 Raglan St. S., Renfrew, K7V 1R6	613-432-4841	Box 2004, Kemptville K0G 1J0	
Carleton	26 Thorncliffe Place, Nepean, K2H 6L2	613-828-9167		
Prescott	Box 110, Plantagenet, K0B 1L0	613-673-5115	P.E. Beaudin,	613-673-5115
Russell	Box 540, 666 Notre Dame St., Embrun, K0A 1W0	613-443-3391	Box 110, Plantagenet, K0B 1L0	
Glengarry	Box 579, Alexandria, K0C 1A0	613-525-1046		

Northern Ontario District Offices

County	Agricultural Representatives		Soils and Crop Specialist	
Algoma	1496 Wellington St. E. Sault Ste. Marie, P6A 2R1	705-253-1161		
Cochrane, North	Experimental Farm, Kapuskasing, P5N 2X9	705-335-5828		
Cochrane, South	Box 608, Matheson, P0K 1N0	705-273-2509		
Kenora	Ontario Government Building, Dryden, P8N 3B3	807-223-2415		
Manitoulin	Box 328, Gore Bay, P0P 1H0	705-282-2043		
Muskoka & Parry Sound	Box 130, Huntsville, P0A 1K0	705-789-5491	Walker Riley	
Nipissing	222 McIntyre St. W., North Bay, P1B 2Y8	705-474-3050	222 McIntyre St. W., North Bay P1B 2Y8	705-474-3050
Rainy River	Front St., Emo, P0W 1E0	807-482-2310		
Sudbury	1414 La Salle Blvd., Sudbury, P3A 1Z0	705-566-1630		
Timiskaming	Box "G", New Liskeard, P0J 1P0	705-647-6701		
Thunder Bay	Ontario Government Building 435 James St. S. Thunder Bay F., P7E 6E3	807-475-1631		

ONTARIO MINISTRY OF THE ENVIRONMENT
PESTICIDES CONTROL FIELD OFFICES

Essex, Kent, Lambton	Box 237, 435 Grand Ave. W., Chatham, N7M 5K3	519-352-5107
Elgin, Middlesex, Oxford	985 Adelaide St. S., London, N6E 1V3	519-681-3600
Brant, Haldimand, Norfolk	645 Norfolk St. N., Simcoe, N3Y 3R2	519-426-1940
Niagara, Hamilton, Wentworth	140 Centennial Parkway N., Stoney Creek, L8E 1H9	416-561-7410
Dufferin, Wellington, Waterloo	Box 219, Clyde Rd., Cambridge, N1R 5W6	519-623-2080
Bruce, Grey, Huron, Perth	Box 688, Clinton, N0M 1L0	519-482-3428
Simcoe, Muskoka	12 Fairview Rd., Barrie, L4N 4P3	705-726-1730
Halton, Peel, York, Durham, Toronto	150 Ferrand Dr., 7th Floor, Don Mills, M3C 1H6	416-424-3000 (ext. 202)
Peterborough, Victoria, Haliburton, Northumberland	139 George St., Peterborough, K9J 3G7	705-743-2972
Frontenac, Lanark, Hastings, Lennox and Addington, Prince Edward, Leeds, Grenville	133 Dalton St., Box 820, Kingston, K7L 4X6	613-549-4000
Prescott, Russell, Renfrew, Stormont, Dundas, Glengarry, Ottawa-Carleton	2378 Holly Lane, Suite 204, Ottawa, K1V 7P1	613-521-3450
Algoma, Manitoulin, Nipissing, Parry Sound, Sudbury	1500 Fisher St., North Bay, P1B 2H3	705-476-1001
Cochrane, Timiskaming	83 Algonquin Blvd. W., Timmins, P4N 4R4	705-264-9474
Kenora, Rainy River, Thunder Bay	Ontario Government Bldg, 435 James St. S., Thunder Bay, P7E 6E3	807-475-1305

POISON CONTROL SPECIALISTS

The Occupational Health and Safety Division, Ministry of Labour, 400 University Ave., Toronto, M7A 1T7 has physicians available for consultation on first-aid information and advice. They can be contacted in the following manner:

Between the hours of 8:00 a.m. and 5:00 p.m. Monday to Friday, telephone (416) 965-3610.

During weekends, public holidays and non-office hours telephone (416) 965-1211 and ask for the "on-call" physician.

See page 49, **Emergency Procedures for Pesticide Poisoning.**

DISTRIBUTORS OF VARIETIES RECOMMENDED IN PUBLICATION 296

Bishop Farm Seeds Ltd	Box 338, Belleville, Ontario K8N 5A5
Dekalb Canada Ltd	Box 430, Chatham, Ontario N7M 5K5
General Seed Co.	Box 32, Station E, Hamilton, Ontario L8S 4K9
King Grain Limited	P.O. Box 1088, Chatham, Ontario N7M 5L6
Maple Leaf Mills Limited	P.O. Box 9, Wallaceburg, Ontario N8A 4L5
Mapleseed Inc.	Oakwood, Ontario K0M 2M0
Northrup King Seeds Ltd	1250 Franklin Blvd. Box 1207, Cambridge, Ontario N1R 6C9
OSECO Inc.	P.O. Box 219, Brampton, Ontario L6V 2L2
Otto Pick & Sons Seeds Ltd	Box 126, Richmond Hill, Ontario L4C 4X9
PAG Seeds	Box 490, Princeton, Ontario N0J 1V0
Pioneer Hi-Bred Ltd	Box 730, Chatham, Ontario N7M 5L1
SeCan*	Suite 512, 885 Meadowlands Drive, Ottawa, Ontario K2C 3N2
Speare Seeds Ltd	P.O. Box 171, Harriston, Ontario N0G 1Z0
Stewart Seeds (CIBA-Geigy Seeds Ltd)	P.O. Box 40, Ailsa Craig, Ontario N0M 1A0
United Cooperatives of Ontario	151 City Centre Drive, Mississauga, Ontario L5A 3A4
W.G. Thompson & Sons Ltd	Box 250, Blenheim, Ontario N0P 1A0

* *For more information, contact your local SeCan member.*

PUBLICATIONS

Available from your local office of the Ontario Ministry of Agriculture and Food

CORN

Corn Production — Publication 13
1981 Ontario Hybrid Corn Performance Trials Report

Factsheets:

111/25 *Corn Lodging*
111/31 *Heat Units for Corn in Southern Ontario*
111/61 *High Moisture Corn*
100/531 *Zinc Requirements for Field Crops*
111/541 *Nitrogen Recommendations for Corn*
111/622 *European Corn Borer*
111/622 *Corn Leaf Aphid*
111/622 *Corn Rootworms*
111/622 *Potato Stem Borer in Field Corn*
111/630 *Stunting of Young Corn*
111/632 *Head Smut of Corn*
111/632 *Leaf Diseases of Field Corn*
111/685 *Bird Damage to Corn*
111/736 *Growing, Harvesting and Storing Quality Grain Corn*
111/742 *Calibrating Your Corn Planter*
111/745 *Measuring Corn Harvesting Losses*
111/840 *Pricing Corn in Ontario*

FORAGES

Alfalfa — Publication 59
Pasture Production — Publication 19
Quality Forage For Milk or Beef — Publication 54
Production and Handling of Forages — Publication 369
Annuals for Supplementary Feed — Publication 47
Hay Crop Silage for Dairy Cattle — Unnumbered

Factsheets:

120/22 *Successful Forage Establishment*
120/31 *Selecting a Perennial Forage*
120/52 *Quality Hay Crop Silage*
120/81 *Protein Supplements from Forage Legumes*
120/30 *Fertilizer Use in Forage Establishment*
120/622 *European Skipper*
120/745 *Large Package Hay Equipment*
121/21 *Alfalfa Persistence*
121/21 *Establishment of Bird's-Foot Trefoil*
121/21 *Stop Alfalfa Winterkill*
121/531 *Boron Requirements for Alfalfa*
121/542 *Fertilizer Practices for Alfalfa Production*
121/622 *Alfalfa Weevil*
121/622 *Alfalfa Blotch Leafminer*
121/622 *Potato Leafhopper in Alfalfa*
121/736 *Determining Moisture Content of Alfalfa Using a Microwave Oven*
122/10 *Red Clover in Ontario*
122/20 *Bird's-Foot Trefoil Production*
122/22 *Establishment of Bird's-Foot Trefoil*
122/30 *Varieties, Seed and Mixtures of Bird's-Foot Trefoil*
136/22 *Trefoil Establishment on Roughland Pastures*

CEREAL GRAINS

Insects in Farm Stored Grain — Publication 229
Smut Diseases of Grain Crops — Publication 524
Oat and Barley Production in Ontario
1981 Regional Test Report Barley, Oats, and Wheat,
Department of Crop Science, University of Guelph

Factsheets:

100/531 *Manganese in Soybean and Small Grain Production*
110/622 *Armyworms*
110/632 *Cereal Fungus Diseases*
110/632 *Cereal Virus Diseases*
110/717 *Grain Aeration*
112/10 *Winter Wheat in Ontario*
112/632 *Leaf Diseases of Winter Wheat in Ontario*
113/632 *Oat-Cyst Nematode*
114/32 *Malting Barley*
114/542 *Fertilizing Practices for Growing Barley*
114/632 *Leaf and Head Disease of Barley*

FIELD BEANS

Factsheets:

142 *Growing White Beans in Ontario*
142/10 *Kidney Beans in Ontario*
142/622 *White Bean Insects*
142/632 *White Bean Diseases*
142/840 *Production & Marketing of White Beans*

FIELD PEAS

Factsheets:

142/13 *Field (Dry) Peas in Ontario*

SOYBEANS

Soybean Production — Publication 173

Factsheets:

100/531 *Manganese in Soybean and Small Grain Production*
141/10 *Getting into Soybeans — Harvesting, Marketing, Storage and Feeding*
141/10 *Getting into Soybeans — Planting and Growing the Crop*
141/745 *Measuring Soybean Harvesting Losses*
141/840 *Pricing and Marketing Soybeans*

HERBICIDES

Guide to Chemical Weed Control — Publication 75
Ontario Weeds — Publication 505 Price *$2.50*

Factsheets:

100/744 *Calibration of Flood-Jet Nozzles*
607 *Pesticide Drift*
642 *Fall Panicum in Ontario*
640 *Proso Millet*
642 *Nutsedge*
642 *Velvetleaf*
642 *Pigweeds (Redroot, Green and Smooth)*

GENERAL INFORMATION

Legume Seed Inoculation — Publication 212
Ontario Soils — Publication 492 Price *$1*

Factsheets:

100/516 *Tillage for Crop Production*
100/540 *Foliar and Liquid Fertilizers*
534 *Soil Acidity and Liming*
542 *Guidelines for Safe Rates of Nutrients Applied at Seeding*
555 *Management of Drained Fields*
555 *Drainage Benefits*
553 *Maintenance of the Drainage System*
540 *Chemical and Organic Fertilizers*
541 *Use of Stabilized Sewage Sludge on Agricultural Land*
562 *Irrigation — Water Supply*
572 *Soil Erosion — Causes and Effects*
573 *Control of Soil Erosion*
573 *Grassed Waterways*
606 *Soil Fumigants*
607 *Protective Clothing When Using Pesticides Outdoors*
607 *Farm Storage of Pesticides*

AVAILABLE FROM INFORMATION SERVICES, AGRICULTURE CANADA, OTTAWA, K1A 0C7

Growing Corn — Publication 1025
Growing Soybeans — Publication 1487
Growing Field Peas — Publication 1493
Growing Flax in Canada — Publication 1577
Growing Buckwheat — Publication 1468
Growing and Using Fababeans — Publication 1540
Sunflower Seed Production — Publication 1019
Red Clover Production — Publication 1614
Timothy — Publication 1640
Alfalfa in Canada — Publication 1377
Alsike Clover — Publication 1264
Manures and Compost — Publication 868
Common Insects of Corn in Eastern Canada — Publication 945
Ergot of Grains and Grasses — Publication 1438
Grain Drying — Publication 1497
Combine Operation and Adjustments — Publication 1464
Field Sprayers — Publication 1482
Control of Groundhogs (folder) — Publication 1587
Insects and Mites of Farm-Stored Grain — Publication 1595
Control of Raccoons (folder) — Publication 1604
Blackbirds and the Protection of Field Crops — Publication 1652

AVAILABLE FROM ONTARIO MINISTRY OF THE ENVIRONMENT FIELD OFFICES

Personal Protective Equipment for Pesticide Users
Chemical Safety Handbook
Pesticides Act and Regulations
Chemical Storage Signs
Factsheet — *Aluminum Phosphide for Groundhog Control*

1982 FIELD CROP RECOMMENDATIONS

Information supplied under the direction of the Ontario Field Crops Research Committee, composed of representatives of the following organizations:

Ontario Agricultural College
- University of Guelph

Ontario Ministry of Agriculture and Food
- Colleges of Agricultural Technology:
  - Centralia
  - Kemptville
  - New Liskeard
  - Ridgetown
- Extension Branch
- Soils and Crops Branch

Agriculture Canada
- Research Station, Harrow
- Research Station, Ottawa
- Research Station, Kapuskasing
- Research Station, Thunder Bay

Ontario Cereal Crops Committee
Ontario Corn Committee
Ontario Field Bean Committee
Ontario Field Crop Protection Committee
Ontario Forage Crops Committee
Ontario Oil and Protein Seed Crops Committee
Ontario Soil Management Research Committee
Ontario Weed Committee

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